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No. 3, Original.

In the Supreme Court of the United States.

OCTOBER TERM, 1906.

STATE OF KANSAS, COMPLAINANT,

v.

STATE OF COLORADO ET AL., AND THE UNITED States, intervenor.

BRIEF FOR THE UNITED STATES ON FINAL HEARING.

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No. 3, Original.

BRIEF FOR THE UNITED STATES ON FINAL HEARING.

I.

STATEMENT.

A brief history of the case, a description of the parties, an abridgment of the pleadings and the petition of intervention are set forth in intervenor's printed abstract. This abstract also contains a synopsis of all the evidence submitted.

The subject-matter of the action is the waters which ordinarily flow in the channel of the Arkansas River in Colorado. This river is an interstate stream. It rises in the mountains of Colorado and flows through said State and into and through the State of Kansas, and thence into and through Oklahoma, the Indian Territory, and the State of Arkansas, and empties into the Mississippi River.

At Canon City, Colo., where it emerges from the mountains, the average flow of the river is about 750 cubic feet per second of time (644[a]). In the amended bill of complaint it is stated at one place, in effect, that the mean average flow of the river at the point where it enters Kansas, if undiverted for irrigation purposes in Colorado, would be 2,000 cubic feet per second of time for ten months in the year (63). At another place in said bill it is stated, in effect, that the mean average flow at any point in Colorado does not exceed 1,400 cubic feet per second (71).

In the answers of all the defendants save one it is alleged, in effect, that the normal flow of the river at the point where it enters Kansas, even if undiminished by diversion in Colorado, would be less than 500 cubic feet per second (81, 82, 102, 126, 164, 190). Complainant did not offer any evidence to support the allegations in its bill in respect to the amount of the normal flow of the river at the point where the same enters Kansas, nor did it offer any evidence to contradict the statements in respect to said flow set forth in defendants' answers. Defendant Colorado's witness, Louis G. Carpenter, testified, in effect, that if there were no diversion of the waters of the river between Canon City and the Kansas-Colorado line the river would lose between those two places (1825), and if uninterfered with by diversion in Colorado the average annual flow of the river at

[a] The figures, unless otherwise stated, refer to pages of the printed transcript of the record, or abstract, reduced from the original record on file.

the State line would be about 500 or 600 cubic feet per second of time (1826). We therefore assume that the normal flow of the river at the point where it enters Kansas, even if not interfered with by diversion in Colorado, would be between 500 and 750 cubic feet per second of time.

The primary purpose of the suit is to obtain such relief by injunction against the defendants as will prevent them or either of them from diverting and using, or from impounding, the ordinary flow of said stream in Colorado "for purposes of irrigation, sale, or merchandise" (75).

The relief asked is based mainly upon the following allegations of fact in the amended bill:

1. That the defendants divert and use all of the ordinary flow of the river in Colorado to irrigate non-riparian lands in said State, and that they do not permit any of the ordinary flow to pass into Kansas (71).

2. That by reason of such diversion great damage has already resulted and still greater damage is threatened to the State of Kansas and its citizens and property holders who reside within the valley of said river in Kansas (73, 75).

3. That the Arkansas River is navigable in Kansas (63, 67).

4. That the diversion and use of the waters of said stream in Colorado for irrigation purposes interferes with and tends to destroy navigation in Kansas (Kans. br., 20–23[a]).

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[a] Kans. br. means brief on behalf of Complainant on Final Hearing.

To support its prayer for relief Kansas invokes:

(1) The doctrine of riparian rights.

(2) The doctrine that a State is the owner of the beds of navigable streams therein.

The principal defenses interposed, as appears from the answers of the defendants, are:

(1) That the State of Colorado is now and since August 1, 1876, has been a sovereign State, and as such "has the plenary and exclusive right and power to control and regulate the use of nonnavigable waters within its boundaries;" and that the "said river is not navigable within either the State of Colorado or the State of Kansas, and that the same is not an avenue or instrumentality of interstate commerce as between the States of Colorado and Kansas" (80).

(2) That the State of Colorado is within what is commonly called the arid region of the United States; that the doctrine of riparian rights does not prevail in said region, and that the law which is applicable thereto and which prevails therein is that the waters of natural streams may be used for the purpose of irrigating and cultivating arid lands (90), riparian and nonriparian.

(3) That the diversion and use of the waters of the river in Colorado do not diminish the ordinary flow of the same at the point where it enters Kansas, but, on the contrary, tend to maintain and equalize the flow thereof through the State of Kansas (83), "diminishing the volume of flood waters and increasing the supply in periods of comparative drought" (84, 87).

The Government, by its petition of intervention, asserts, in effect:

(1) That the Arkansas River is not and never was practically navigable beyond Fort Gibson in the Indian Territory (235).

(2) That the doctrine of riparian rights is inapplicable to conditions prevailing in the arid region; that such doctrine, if applicable in said region, would prevent the sale, reclamation, and cultivation of the public arid lands, and defeat the policy of the Government in respect thereto; that the doctrine which is applicable to conditions in said arid region, and which prevails therein, is that the waters of natural streams may be used to irrigate and cultivate arid lands, whether riparian or nonriparian, and that the priority of appropriation of such waters and the application of the same for beneficial purposes establishes a prior and superior right (236).

(3) That a State has no such ownership or control of the waters of natural streams therein as warrants it in depriving a prior appropriator in a State below of the waters so appropriated and used for a beneficial purpose (239).

ARGUMENT.

II.

THE INTEREST THE GOVERNMENT HAS IN THE QUESTIONS INVOLVED, AND IN THE RESULT OF THE ACTION, AND ITS RIGHT TO INTERVENE.

As appears from the petition of intervention and from the evidence submitted by the Intervenor, in the water shed of the Arkansas River in western Kansas and in Colorado there are about 100,000 acres of public land, which, in their present condition, are unproductive, uninhabitable, unsalable, and practically valueless because of insufficient rainfall (238), but which can be reclaimed and rendered productive, habitable, salable, and valuable, and made to sustain a population of at least 50,000 persons by applying the waters of said stream and the flood and other waters which now flow, undiverted and undiminished, in the channel; that in the arid region of the United States, including that part of the watershed of the river just mentioned, there are from 60,000,000 to 150,000,000 acres of public land which are now practically valueless and which can be rendered fruitful, habitable, and salable by means of irrigation, and, if so reclaimed, will be worth from $50 to $500 an acre and made to sustain a population of from 50,000,000 to 100,000,000 persons (237, 238, 1165).

The evidence also shows that there are forty-seven Indian reservations situated within the arid region of the United States, containing, in the aggregate, 48,000,000 acres, upon which there are located 116,000 Indians; that these reservations can only be made

to support the Indians residing thereon by irrigating from the streams the lands within said reservations; that already there are 200,000 acres within these reservations covered by irrigating canals, and that the Government has entered upon the policy of assisting the Indians to reclaim the lands within the reservations by the method of irrigation (1315–1324).

The Government is deeply interested, therefore, in the decree to be entered, to the end that the reclamation of its arid lands may not be retarded or prevented.

Its right to intervene for this purpose would seem to be settled by the decisions of the court, beginning with *Florida* v. *Georgia*, (17 How., 478).

In the opinion of the Government's counsel, the relief asked for by complainant would require a decree the force and effect of which would prevent the reclamation and cultivation of any of the public lands which lie within the arid belt. They are also of the opinion that a decree sustaining the contention of the defendants to the effect that the State of Colorado has "plenary and exclusive right and power to control and regulate the use of nonnavigable streams within its boundaries" would, in large measure, prevent private persons and the Government from expending any money in irrigation enterprises in a lower State along an interstate stream, and that the refusal on the part of private persons or the Government so to expend money in irrigation enterprises would result in the placing of a limit upon the amount of arid land which will be reclaimed in the future.

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III.

JURISDICTION OF THE COURT TO ENTERTAIN THE ACTION. OWNERSHIP OF THE BED OF MEANDERED NON-NAVIGABLE STREAMS. THE NAVIGABLE CAPACITY OF THE ARKANSAS RIVER.

The first proposition of law advanced by Kansas is in regard to the jurisdiction of this court to entertain the case (Kans. br., 186), and is as follows:

> The State of Kansas may maintain this suit, first, by virtue of its own sovereignty; second, as the owner of the bed of the Arkansas River; third, as the owner of riparian lands in the Arkansas Valley; fourth, as *parens patriae*, guardian or trustee, for any considerable portion of its territory or citizens affected by any unlawful diversion of the waters of the river; and fifth, because its revenue derived from taxation has been directly diminished by such diversion. Such cause is justiciable in this court, the defendants are each necessary and proper parties, and this court has jurisdiction and power to grant relief.

The intervenor concedes that this court has original jurisdiction in this action. It does not concede, however, as claimed by complainant and as set forth in the above proposition, that the State of Kansas is "the owner of the bed of the Arkansas River" in Kansas. On the contrary, the Government denies this claim and insists that if the original jurisdiction of this court depended upon this alleged fact the action would have to be dismissed. The Government contends that the title to the bed of the stream in Kansas is vested in the owners of the abutting land

on either side, or is in the United States. It submits that inasmuch as the abutting owners are not now before the court this question should not be decided adversely to them. The Government's contention in respect to the ownership of the bed of the river in Kansas is based upon the fact, as conclusively shown by the evidence, that the river never was navigable in that State. The claim of the State of Kansas in respect to said ownership is based upon the fact as shown by the evidence, that when the public survey was extended over the public lands in Kansas which border on the river its bed was excluded by meandered lines on either side. From this fact, so established, counsel for complainant assert, as a proposition of law (Kans. br., 192) that—

> When the Government meanders a stream and sells the adjoining land, and treats the stream as if it were navigable, the title to the soil between the meandered lines vests in the State.

They further add:

> This has been decided so often that there is no controversy on the subject.

The Government contends that this proposition is not sound, and that it finds no support whatever in any authority cited in complainant's brief. The authorities cited will be hereafter noticed and analyzed. Instead of having been "decided often," as counsel for complainant assert, counsel for the intervenor, after diligent search, have failed to find that the proposition as stated has ever been decided by any court.

Counsel for complainant, in their brief (Kans. br., 191) state, among other things, in effect that the Government, in extending the public survey over the public lands "had the right either to meander the stream and call the river navigable, or to survey across it and sell the bed of the stream as land, if it deemed the river to be in fact not navigable." Further, that the bed of the river between the "meander lines * * * has never been sold by the United States * * * and has never been conveyed by" it "for any purpose whatever," and that when "Kansas was admitted into the Union the bed of the Arkansas River * * * passed to the State."

The Government concedes that when the public survey was extended over the public lands in the Arkansas Valley in Kansas the surveyors were authorized to run meander lines along the banks of the Arkansas River, whether the same was navigable or nonnavigable. It does not concede that the surveyors had the right to designate the river to be navigable, unless it was so in fact. It does not concede that the making of the meander lines had any significance whatever, so far as the character of the stream is concerned. It does concede that the ownership of beds of navigable streams and navigable lakes, below high-water mark, is in the States where such streams and lakes are situated, and that the ownership of lands bordering upon navigable streams and navigable lakes between the meandered lines and high-water mark depends upon the law of the State where such lands are located. It contends that the Arkansas River never

was and never could be made a navigable stream within the State of Kansas; that whether the title to the lands between the meandered lines of the river has passed from the United States is a question of law, and that if such title has passed it became vested in the patentees of the lands bordering on the streams and not in the State.

(1) *There is no statute which requires the meandering of nonnavigable streams.*

There is no specific provision of law, and never was, which requires streams or other bodies of water, nonnavigable, to be meandered by the public survey. The only statutory authority for the meandering of any stream or body of water is to be found in the first paragraph of section 2395, the second paragraph of section 2396, sections 2399 and 2407 of the Revised Statutes, and the act of October 1, 1890 (26 Stat., 650), which read as follows:

> SEC. 2395. The public lands shall be divided by north and south lines run according to the true meridian, and by others crossing them at right angles, so as to form townships of six miles square, unless where the line of an Indian reservation or of tracts of land heretofore surveyed or patented, or the course of navigable rivers, may render this impracticable; and in that case this rule must be departed from no further than such particular circumstances require. * * *
>
> SEC. 2396. * * * The boundary lines, actually run and marked in the surveys returned by the surveyor-general, shall be estab-

lished as the proper boundary lines of the sections, or subdivisions, for which they were intended, and the length of such lines, as returned, shall be held and considered as the true length thereof. And the boundary lines which have not been actually run and marked shall be ascertained by running straight lines from the established corners to the opposite corresponding corners; but in those portions of the fractional townships where no such opposite corresponding corners have been or can be fixed, the boundary lines shall be ascertained by running from the established corners due north and south or east and west lines, as the case may be, to the water course, Indian boundary line, or other external boundary of such fractional township.

SEC. 2399. The printed manual of instructions relating to the public surveys prepared at the General Land Office, and bearing date February twenty-second, eighteen hundred and fifty-five, the instructions of the Commissioner of the General Land Office, and the special instructions of the surveyor-general, when not in conflict with such printed manual, or the instructions of the Commissioner, shall be taken and deemed to be a part of every contract for surveying the public lands.

SEC. 2407. Whenever, in the opinion of the President, a departure from the ordinary method of surveying land on any river, lake, bayou, or water course would promote the public interest, he may direct the surveyor-general in whose district such land is situated and where the change is intended to be made, to

cause the lands thus situated to be surveyed in tracts of two acres in width, fronting on any river, bayou, lake, or water course, and running back the depth of forty acres; which tracts of land so surveyed shall be offered for sale entire instead of in half-quarter sections, and in the usual manner and on the same terms in all respects as the other public lands of the United States.

Act of October 1, 1890 (26 Stat., 650), amending sec. 2399, Revised Statutes.—The printed manual of surveying instructions for the survey of the public lands of the United States and private land claims, prepared at the General Land Office, and bearing date December second, eighteen hundred and eighty-nine, the instructions of the Commissioner of the General Land Office, and the special instructions of the Surveyor-General, when not in conflict with said printed manual or the instructions of said Commissioner, shall be taken and deemed to be a part of every contract for surveying the public lands of the United States, and private land claims.

However, from inquiry at the Division of Public Surveys in the General Land Office, it appears that since 1855, in extending the public survey over the public lands, it has been the uniform custom to run meander lines along the banks of streams of more than three chains in width and bodies of still water of more than 25 acres in extent, whether navigable or nonnavigable, although the "Manual of Instructions" of February 27, 1855, which is mentioned in

section 2399 of the Revised Statutes, did not require that nonnavigable streams be meandered, but did require meandering of all lakes or deep ponds of an area of 25 acres and upwards. May 21, 1881, another Manual of Instructions was issued, of which section 2, page 33, provided, in part—

> * * * both banks of navigable rivers are to be meandered by taking the general courses and distances of their sinuosities, and the same are to be entered in the field book.

Paragraph 3, page 34, provides, in part—

> * * * rivers not embraced in the class denominated "navigable" under the statute, but which are well-defined arteries of internal communication will only be meandered on one bank.

December 2, 1889, another "Manual of surveying instructions for the survey of public lands," etc., was issued by the General Land Office, and published January 1, 1890. Sections 2 and 3 of this manual, under the title "Meandering," pages 33 and 34, read as follows:

> SEC. 2. Both banks of *navigable* rivers, as well as of all rivers not embraced in the class denominated as "navigable," the right-angle width of which is three chains and upwards, will be meandered on both banks by taking the general courses and distances of their sinuosities, and the same are to be entered in the field book. Rivers not classed as navigable will not be meandered above the point where the average right-angle width is less than three chains. * * *

SEC. 3. You are also to meander, in manner aforesaid, all lakes and deep ponds of the area of twenty-five acres and upwards; also navigable bayous; shallow ponds, readily to be drained or likely to dry up, are not to be meandered. * * *

January 1, 1902, another such manual was issued and published. Under the title "Meandering" appear sections 153, 157, 158, and 164, which are as follows:

SEC. 153. The running of meander lines has always been authorized in the survey of public lands fronting on large streams and other bodies of water, but does not appear to have been proper in other cases. The mere fact that an irregular or sinuous line must be run, as in the case of a reservation boundary, does not entitle it to be called a meander line except where it closely follows a stream or lake shore. The legal riparian rights connected with meandered lines do not apply in case of other irregular lines, as the latter are strict boundaries.

SEC. 157. Navigable rivers, as well as all rivers not embraced in the class denominated "navigable," the right-angle width of which is three chains and upwards, will be meandered on both banks, at the ordinary mean high-water mark, by taking the general courses and distances of their sinuosities, and the same will be entered in the field book. Rivers not classed as navigable will not be meandered above the point where the average right-angle width is less than three chains, except that

streams which are less than three chains wide and which are so deep, swift, and dangerous as to be impassable through the agricultural season, may be meandered, where good agricultural lands along the shores require their separation into fractional lots for the benefit of settlers. But such meander surveys shall be subject to rejection if proved unnecessary by field inspection.

SEC. 158. Shallow streams, without any well-defined channel or permanent banks, will not be meandered; except tide-water streams, whether more or less than three chains wide, which should be meandered at ordinary high-water mark, as far as tide water extends.

At every point where either standard, township, or section lines intersect the bank of a navigable stream, or any meanderable shore, corners will be established at the time of running these lines. Such corners are called meander corners, and the deputy will commence at one of these corners, follow the bank or boundary line, and take the bearing and measure the length of each course, from the beginning corner to the next meander corner.

SEC. 164. The meanders of all lakes, navigable bayous, and deep ponds of the area of 25 acres and upwards, will be commenced at a meander corner and continued, as above directed for navigable streams; from said corner, the courses and distances of the entire margin of the same, and the intersections with all meander corners established thereon, will be noted.

It will be seen from the above that the meandering of nonnavigable streams and nonnavigable lakes or ponds of water by the public survey, is based upon long continued use and custom, which recently found expression in the rules and regulations promulgated by the Land Department.

It will not be disputed that the evidence shows that the Arkansas River in Kansas is more than three chains in width and that it was meandered by the public survey; further, that the public lands in said State bordering on said river were surveyed subsequent to 1855. The evidence and Land Office records disclose that they were surveyed prior to 1881; therefore they were surveyed in accordance with the usage and custom prevailing prior to that time and under the rules and regulations as set forth in the "Manual of Instructions" of February 25, 1855.

(2.) *The force and effect to be given to actions of surveying officers by which nonnavigable streams are mean-*

The act of meandering a nonnavigable stream determines nothing in respect to the title to its bed between the meandered lines. (*Iowa* v. *Rood*, 187 U. S., 87, 93.) In that case the court said, at page 93:

> It was obviously beyond the powers of a government surveyor, or of the Land Officers, to determine the title to these lands, or to adjudicate anything whatever upon the subject.

"There is no such magic in a meandered line," said Mr. Justice Brewer, in *Niles* v. *Cedar Point Club* (175 U. S., 300, 308). "And," says Mr. Justice Holmes in *Kean* v. *Calumet Canal Company* (190 U. S., 452, 459), "the making of a meander line has no certain significance." Again he says: "It is not always a boundary."

In *Railroad* v. *Schurmeir* (7 Wallace, 272, 286-7), Mr. Justice Clifford said:

> Meander-lines are run in surveying fractional portions of the public lands bordering upon navigable rivers, not as boundaries of the tract, but for the purpose of defining the sinuosities of the banks of the stream, and as the means of ascertaining the quantity of the land in the fraction subject to sale, and which is to be paid for by the purchasers.

In *Hardin* v. *Jordan* (140 U. S., 371) the court, at page 380, says:

> The meander lines running along or near the margin of such waters [nonnavigable fresh water lakes] are run for the purpose of ascertaining the exact quantity of the upland to be charged for, and not for the purpose of limiting the title of the grantee to such meander lines.

If there is no certain significance to be attached to meander lines, so far as regards the title to the lands lying between them is concerned, there certainly can be no significance attached thereto as to the character of such stream, whether navigable or not, which has been meandered.

(3.) *The authorities cited by counsel for complainant in their brief, at pages 191 and 192, do not sustain their contention in respect to the title to the bed of the Arkansas River in Kansas.*

Preliminary to an analysis of the authorities so cited, it is pertinent to state that we are now proceeding on the assumption—which is based upon the evidence, as will be hereafter shown—that the Arkansas River in Kansas never was navigable and can not be made so. It is also proper to state at this time and in this connection that in none of the authorities so cited by counsel for complainant, as an examination will disclose, was there involved the title to the bed of a nonnavigable stream.

In *La Plaisance Bay Harbor Co.* v. *Monroe* (1 Walker Ch. Mich., 155), the complainant had obtained a temporary injunction against the city of Monroe, restraining the latter from erecting a dam on the river Rasin, a meandered stream and conceded to be *navigable*. The injunction was dissolved on motion of defendant. In the course of the opinion the court says, at page 168:

> The complainants do not own either the bed, or the banks, of the river, below the point of obstruction. The bed of the stream is public property, and belongs to the State. This is the case with all meandered streams, no part of them being included in the original survey; and the common-law doctrine of *usque ad filum aquæ* is not applicable to them. The public owns the bed of this class of rivers, and is not

limited in its right to an easement, or right of way only.

It appears from the case that the court was dealing not only with a meandered stream but one of unquestioned *navigability*, and the language employed by the court must be taken in connection with the facts involved. The court did not say, as contended for in complainant's brief, that simply because a stream is meandered its bed belongs to the State. On the contrary it said that "the public owns the bed of *this class* of rivers."

Sec. 1, Chap. XXXIV, of the Revised Statutes of Wisconsin (1850), cited in complainant's brief, does not recognize, as claimed by counsel, that the bed of the stream belongs to the State simply because the stream has been meandered and returned as navigable by the Government surveyors. That section is but a declaration that under the constitution of Wisconsin permission must first be obtained from the legislature before a meandered stream can be obstructed by a dam, bridge, or other obstruction. Such constitutional and statutory provisions would be competent to a State even if the stream were navigable in fact, and subject to the control of Congress because of interstate navigability. The State could subject a proposed obstruction to the necessity of its permission even if Federal permission were also requisite. In this realm, at least, a State can always act until Congress assumes the power of exclusive action (*Manigault* v. *Springs*, 199 U. S., 473). Such

authority of a State is *a fortiori* as to a stream merely meandered, but not navigable in fact.

The next case cited in complainant's brief is *Cox* v. *The State*, 3 Blackf. (Ind.), 193. In that case Cox was tried and convicted upon an indictment drawn under the statute of Indiana making it a penal offense for any person to erect or maintain any milldam or other artificial obstruction in or across the bed or channel of any *navigable* stream, the bed or channel not having been surveyed and sold as land by the United States. The indictment contained two counts. The first charged the defendant with erecting and maintaining a milldam across the bed of the west branch of the White River, thereby destroying its navigation. The second count charged him with the erection and maintenance of a milldam across the main channel of the White River, and that such dam was calculated to destroy and injure its navigability, the same being a public highway. The validity of the statute was attacked on the ground that navigable streams were not within the control or protection of the State but of the United States. The statute was held to be valid and that the General Government had no right in or control over such streams in said State, having disposed of the same to the State; that the legal title to the bed of such streams still remained in the United States, and that such beds have "been irrevocably disposed of for express and certain uses and purposes and can not be sold by the United States." Further, that the State, by virtue of the compact with

the Federal Government, was prohibited from obstructing navigable streams therein.

Counsel for complainant, in quoting from the opinion of the court in the above case (Kans. br., 191–192), omits certain language, thereby changing—of course unintentionally—the meaning of the text. Their quotation reads:

> It is further insisted by the counsel of the plaintiff in error that, inasmuch as the United States has not surveyed and sold the bed of this stream (the west branch of the White River, Indiana), it still belongs to the United States and stands on the same foot that the other unsold lands stand on. * * * This position is not tenable.

The exact language used, with the omitted words *italicized*, was as follows (3 Blackf., 197):

> It is further insisted by the counsel for the plaintiff in error that inasmuch as the United States have not surveyed and sold the bed of this stream as land it still belongs to the United States, and stands on the same foot that the other unsold lands stand on *and that the State has no power to legislate over these public lands. To sustain this point, the case of the People v. Godfrey, 17 Johns. Rep., 225, is relied on.* This position is not tenable; *the premises from which the conclusion is drawn are not correct. The bed of this stream does not stand on the same foot of the United States' unsold lands; there is no analogy whatever between them. The bed of this stream has been irrevocably disposed of, for express and certain uses and purposes, and can not be sold by the United States.*

What was contended for by counsel for plaintiff in error in that case was that the bed of the stream not having been surveyed and sold by the United States, the same was public land and the State had no power to legislate concerning it. The court held that the Government had irrevocably disposed of the bed of the stream for express and certain uses and purposes, and that there was no analogy between such bed and unsold lands of the United States. The opinion of the court in said case lends no support whatever to the proposition advanced by the State of Kansas, viz., that simply because a stream which flows through public lands was meandered by the public survey, title to its bed thereby passed to the State.

The next case cited by counsel for complainant is that of *Mayor and Alderman of the City of Mobile* v. *Eslava* (9 Porter, Ala., 577). In this case was involved the title to a tract of land in Mobile, Ala., situate on an open space between high and low water mark in the Mobile River (a navigable stream at that time), in front of Fort Charlotte and between it and the river, and within the picket fence that once surrounded the fort. Complainants claimed title under an act of Congress passed in 1824, granting certain lands to the city of Mobile. Defendants claimed title under an act of Congress authorizing the sale of Fort Charlotte and patents issued in pursuance of such act. The court held that inasmuch as the tract was between high and low water mark the act of Congress of 1824 which attempted to confer title upon the city of Mobile was inoperative. By way of reca-

pitulation, the court, among other things, says (pp. 603, 604):

> 1. That the "navigable waters" within this State have been dedicated to the use of the citizens of the United States, so that it is not competent for Congress to grant a right of property in the same.
>
> 2. That navigable waters extend not only to low water, but embrace all the soil that is within the limits of high-water mark.
>
> 3. By the acts of Congress regulating the survey and disposal of public lands, the Federal Government has renounced *the title* to the navigable waters, and the soil covered by them.

The case was brought to this court under the twenty-fifth section of the judiciary act of 1789, (see 16 Pet., 234) and the judgment of the Supreme Court of Alabama was affirmed. (See p. 247).

In regard to this case and other cases of a similar character which had been appealed from the Supreme Court of the State of Alabama, Mr. Justice Gray, in *Shively* v. *Bowlby* (152 U. S. 1, 26, 27), says:

> In *Pollard* v. *Hagan* (1844) this court, upon full consideration, (overruling anything to the contrary in *Pollard* v. *Kibbe*, 14 Pet., 353; *Mobile* v. *Eslava*, 16 Pet., 234; *Mobile* v. *Hallett*, 16 Pet., 261; *Mobile* v. *Emanuel*, 1 How., 95, and *Pollard* v. *Files* 2 How., 591), adjudged that upon the admission of the State of Alabama into the Union the title in the lands below high-water mark of *navigable waters* passed to the State and could not afterwards be granted away by the Congress of the United States.

In *Wood et al* v. *Fowler et al* (26 Kans., 682), the complainants below, Wood et al., had leased from one Spitely, the owner thereof, certain lands riparian to the Kansas River, a meandered, and, at the time when meandered, a navigable stream at the point where said lands were located. The defendants, Fowler et al., claimed the right to cut and were cutting ice from the river opposite said land. Complainants brought suit to enjoin. Judgment was entered for defendants, which judgment was affirmed on appeal to the Supreme Court of the State upon the ground mainly (as shown by the syllabus of the case) that "A riparian owner owns only to the bank and not to the center of a navigable stream"; that the bed of the river where the lands were located belonged to the State, that "where there is no ownership of the subjacent soil a riparian proprietor has no title to the ice," and that "obviously the ownership of the ice would rest in the general public or in the State as the representative of that public." (See p. 690.)

The court did not hold that because the Kansas River had been meandered the soil between the meandered lines vested in the State, but held that it would take judicial notice of the fact that the stream had been meandered by the public survey; that it was the largest stream in the State; that it had been navigable in early times by steamboats; "and that its volume of water is such that in its natural condition it is capable of being used for purposes of navigation, and so coming within the recognized definition in this country of a navigable stream." It was

assumed that at the point in controversy the said stream was navigable. (See p. 688.)

In commenting upon the distinction recognized in England between navigable and nonnavigable stream, the court observes, (p. 689):

> The better and more generally accepted rule in this country is to apply the term "navigable" to all the streams which are in fact navigable; and in such case to limit the title of the riparian owner to the bank of the stream. Especially is this true in the States where the lands have been surveyed and patented under the Federal law.

In *Rossmiller* v. *State* (89 N. W. Rep., 839) the only question involved was whether a statute of the State of Wisconsin was constitutional which declared that ice formed upon the meandered lakes therein to be the property of the State and which prohibited the shipment of such ice out of the State except under a license. The court declared that the act was not constitutional and held that the State had no ownership of ice formed on public waters.

In *Richardson* v. *U. S.* (100 Fed. Rep., 714) no question was considered or presented as to the effect the meandering of a stream had upon the title to its bed. The decision, among other things, stated that the York River in Virginia was a navigable stream and that the court "would take judicial cognizance of the title of the State of Virginia in the bed of this navigable stream" (See p. 716); that the State holds

the beds of navigable streams "in trust for the public for the purposes of commerce and navigation, and subject to these purposes" (See p. 717).

In *Pollard's Lessees* v. *Hagan et al.* (3 How., 212) plaintiffs brought an action in ejectment against defendants in the State court of Alabama to recover a town lot in the city of Mobile. The plaintiffs claimed possession under a title derived from the United States. At the trial the court charged the jury "that if they believed the premises sued for were below the usual high-water mark at the time the State of Alabama was admitted into the Union, then the act of Congress and the patent in pursuance thereof could give the plaintiff no title." The jury returned a verdict in favor of the defendants, upon which judgment was rendered by the court. This judgment was afterwards affirmed by the Supreme Court of the State. Subsequently it was brought on writ of error to this court and affirmed. The question considered and decided in this court was "whether Alabama is entitled to the shores of the navigable waters, and the soils under them, within her limits." The court held that it was and, among other things, stated:

> The shores of navigable waters, and the soils under them, were not granted by the Constitution to the United States, but were reserved to the States, respectively.

It will be noticed that in that case Mr. Justice Catron dissented (pp. 230–235).

The case of *Martin* v. *Waddell* (16 Pet., 367) is clearly and concisely stated and analyzed by George W. Biddle, for many years a leader at the Philadelphia bar, in his lecture entitled "Constitutional Development in the United States as Influenced by Chief Justice Taney," which appears in the publication "Constitutional History as Seen in American Law" (pp. 123–199.) At pp. 147, 148, and 149 he says:

> The case of *Martin* v. *Waddell* involves a question of public law of so much interest, and was presented with so much force, both in the arguments of the distinguished counsel in the cause as well as in the opinion of the court delivered by Chief Justice Taney, and in the dissenting opinion of Justice Thompson, that I do not feel justified in passing it by. It arose under a conflict between two alleged grantees from the State of New Jersey, of certain mud flats covered by the waters of the Bay of Amboy. From several propositions asserted in the judgment of the court, the following may be selected as sufficiently indicating the nature of the controversy and the line of judicial reasoning adopted and leading to the conclusions reached:
>
> 1. The right of the King of Great Britain to make a grant of the soil beneath the navigable waters of Raritan River and bay, where the tide ebbs and flows, included in the territory of the colony granted to the Duke of York, can not, at this day, be questioned.

2. When the revolution took place the people of each State became sovereign, and held an absolute right to their navigable waters and the soil under them, subject only to the rights since surrendered to the General Government. Grants, therefore, made by the States, must be tried and determined by different principles from those which apply to grants of the British Crown, which are construed strictly.

3. While rivers, bays, and arms of the sea undoubtedly passed to the Crown's grantee, yet the public and common rights of fishery in navigable waters required very plain language to be included in the grant under the charter of the Duke of York.

4. The land under the navigable waters within the limit of the charter passed to the grantee as a royalty incident to the powers of the government, and when a surrender was made by the proprietors, in 1702, to the Crown, of all powers, authorities, and privileges of and concerning the government of the province, the rights in dispute were included. They were restored in the same condition in which they came to the Duke of York.

5. When the people of New Jersey took the sovereignty into their hands, the prerogatives and royalties, including the rights in question, which had belonged either to the Crown or to the Parliament, vested immediately in this State.

6. The effect of the judgment of the highest court of New Jersey upon these questions is very great, and in a case free from reasonable doubt should be conclusive.

The chief justice, after giving the history of the discovery of the country, the rules which applied to the ownership of the discovered country, and the grant by the Crown to the Duke of York, laid down the rules by which such grants were to be construed, which have been stated above. The great question was whether the dominion and property in the navigable waters of the province, and the soil under them, passed as part of the prerogative rights annexed to the political powers conferred upon the proprietary, or whether they were granted as private property to be parceled out and sold to individuals for the benefit of the grantee. From a consideration of the laws and institutions of England, the history of the times, the object of the charter, the contemporaneous construction given to it, the usages under it for more than a century, it would seem that the title to the soil under the navigable rivers did not pass as private property, even under words apt for the purpose of the conveyance of such rights in ordinary grants. These rights remained in the dominion and ownership of the State, as part of the prerogative rights annexed to the political powers conferred upon the original proprietary grantee of the Crown to which the State had succeeded.

Much, doubtless, may be urged in favor of this judgment of the Supreme Court, which came to the same conclusion that had been reached by the highest court of the State of New Jersey. Nevertheless, it may be said that the dissenting opinion of Justice Thompson,

concurred in by Justice Baldwin, puts the argument very powerfully against the pretensions of the State of New Jersey, whose claim in the present case appeared to be inconsistent with its own course of practice. It is believed that the practice of the land offices of several of the States is in accordance with the views expressed in the opinion of Justice Thompson, and that the title to the soil lying under the bed of navigable rivers has not infrequently been granted to private individuals. This case coming up again, the same judgment was pronounced, *Martin* v. *Waddell* being affirmed.

Packer v. *Bird* (137 U. S., 661) was an action brought in the State court of Calusa County, Cal., for possession of an 80-acre island in the Sacramento River at a point where the stream was found to be navigable. The question involved, as stated by Mr. Justice Field (p. 666), was "whether the patent of the United States describing the eastern boundary of the land as commencing *at a point on the river*, which was on the right and west bank, and running southerly *on its margin*, embraces the island within it, or whether, notwithstanding the terms of apparent limitation of the eastern boundary to the margin of the river, the patent carries the title of the plaintiff holding under it to the middle of the stream." The plaintiff contended that the patented land being bounded by the river extended to the middle of the stream and thus included the island. He proceeded upon the assumption that the river at the island was

not affected by the tides. This court, among other things, held (syllabus):

> The highest court of California having decided that the Sacramento River being navigable in fact, a title upon it extends no farther than to the edge of the stream, this court accepts that decision as expressing the law of the State.

The point involved in the case of *Illinois Central Railroad* v. *Illinois* (146 U. S., 387) is concisely stated by Mr. Hampton L. Carson in his work entitled "History of the Supreme Court of the United States," (1902) in Volume II, at pages 580–581, as follows:

> In *Illinois Central Railroad* v. *Illinois* the object of the litigation was to determine the rights, respectively, of the State, of the city of Chicago, and of the railroad company in land submerged or reclaimed in front of the water line of the city on Lake Michigan. It was declared that the ownership of and dominion and sovereignty over lands covered by tide waters, within the limits of the several States belong to the respective States within which they were found, with the consequent right to use or dispose of any portion thereof, but subject to the interest of the public in the waters, and subject also to the right of Congress, which was paramount, to control their navigation for the regulation of foreign and interstate commerce. The same doctrine applied to lands under the navigable waters of the Great Lakes. The rule to be followed was that of the common law as to dominion over lands overflowed by the tides

> of the sea. The rights of the United States in the lake front were considered in the later case of *United States* v. *Illinois Central Railroad Company*.

The case of *Shively* v. *Bowlby* (152 U. S., 1) involved the question of title to a tract of land in the city of Astoria, Oreg., fronting on the Columbia River (a navigable stream) between high and low water marks. The plaintiff in error claimed the tract under title derived from the Government, while the defendant in error claimed the tract under a title from the State of Oregon. The question presented and considered by the court was whether the State or the United States had the disposition of lands situated on a navigable river below high water mark. In regard to this question the decision was in favor of the State.

(*4*) *The question in respect to the ownership of the bed of a nonnavigable stream between meandered lines, made by the Government surveyors, has never been directly involved and passed upon by this court.*

This question was considered and commented upon, though not directly involved, in the case of *Railroad Company* v. *Schurmeir* (7 Wallace, 272), where the court says, at page 287:

> Proprietors bordering on streams not navigable, unless restricted by the terms of their grant, hold to the center of the stream.

The question was involved in *Whitaker* v. *McBride* (197 U. S., 510), but was not passed upon, manifestly

for the reason that the United States was not a party to the suit (see p. 515). This case will be referred to hereafter.

While the court, in effect, held in *Grand Rapids and Indiana Railroad Company* v. *Butler* (159 U. S., 87) that a grant of land in Michigan bordering on either a navigable or nonnavigable stream carried with it the bed to the center of the thread thereof, basing said holding on an unbroken line of authorities in that State on that subject, yet an examination of the case shows that the controversy was in respect to the ownership of an island in a meandered stream which was navigable when meandered.

In each of the cases of *Hardin* v. *Jordan* (140 U. S., 371), *Mitchell* v. *Smale* (id., 406), and *Kean* v. *Calumet Canal Co.* (190 U. S., 452), there was involved the question of the ownership of lands bordering on nonnavigable fresh-water *lakes*, which had been excluded by the public survey by meandered lines.

In each case it was held that the question of such ownership depended upon the law of the State in which the lands are situated.

In view of what the court said in *Railroad Company* v. *Schurmeir, supra*, of the dissenting opinions in each of the two cases last named, and of the latest holding of this court, in which there is no dissent (*Whitaker* v. *McBride, supra*), we confidently believe that the doctrine announced in *Hardin* v. *Jordan*, followed in *Mitchell* v. *Smale* and *Kean* v. *Calumet Canal Company*, and apparently limited and restricted in *Whitaker* v. *McBride*, will not be extended

to the lands in the bed of a nonnavigable stream between meandered lines. We respectfully submit that the doctrine announced in *Railroad Company* v. *Schurmeir, supra,* to the effect that the grantee of public lands bordering on a nonnavigable stream takes to the center of the channel thereof unless restricted by the terms of the grant, is correct.

In the case of *Whitaker* v. *McBride* there was involved the question of the ownership of an island of about 21 acres in area within the State of Nebraska, located in the center of the Platte River, a meandered nonnavigable stream at that point. The island was between the meandered lines, and the public survey had not been extended over it. At the point in question the river runs from the west easterly. The lands riparian to the stream on either side opposite to the island had passed from the United States under patents. On the south side the title was in one McBride, and on the north side in one Kilgore. Whitaker settled on the island, claiming that the same was public lands. He applied to the Land Department to have the same surveyed in order that he might procure title from the Government under the homestead law. McBride and Kilgore claimed the island between them, but could not agree upon the dividing line. The former instituted a suit in the district court of the county where the island is located against Whitaker "to quiet his title to so much of the island as might fall within the terms of his grant." (See 90 N. W. Rep., 967.) The trial court held that "the title to said island still remains in the United

States." Both McBride and Kilgore appealed, with the result that the Supreme Court of the State, adopting the report of the Supreme Court Commissioners, reversed the decree of the lower court and ordered the cause to be "remanded, with directions to enter a decree quieting the title to the north half of the island in dispute in the defendant, Kilgore, and to the south half thereof in the plaintiff, McBride." (90 N. W. Rep., 973.) In the opinion of the Supreme Court Commissioners, approved by the Supreme Court of the State, is found the following language, at page 972:

> We do not wish to be understood as undertaking in this opinion to determine the rights of anyone except the parties to the record, or to have the impression go out that any claims of the State to the bed of the Platte River or to any unsurveyed islands therein are intended to be affected in any manner by what has been said. We have only aimed to settle the rights of the parties as among themselves, and if the State should hereafter present any claim of ownership to the bed of the river we desire to to be left free to determine the question as the merits of the case may demand, and without reference to anything that may have been said in the foregoing opinion. It is settled by the decisions of the Supreme Court of the United States that a grant by the General Government of public lands bounded on streams releases the Government title to the middle of the stream, unless some reservation is con-

tained in the grant; but whether the title enures to the State in which the land lies or to the grantee of the Government depends upon the law of the State. (*Hardin* v. *Jordan*, 140 U. S., 371.) As the question of the rights of the State has not been presented in this case, we reserve that question until a case arises in which we may have the benefit of the argument of counsel; it being one of too much importance to be determined without a full discussion. That, as against everyone but the State, or those claiming through the State, McBride and Kilgore have the better right to the land in dispute seems to us too plain for discussion; and that they are entitled to relief as against Whitaker, a naked trespasser on their prior undisputed and peaceable possession, is not a question for debate.

On appeal to this court the judgment of the Supreme Court of Nebraska was affirmed (197 U. S., 510). At page 515, however, this court says:

It must also be noticed that the Government is not a party to this litigation, and nothing we have said is to be construed as a determination of the power of the Government to order a survey of this island or of the rights which would result in case it did make such survey. As we reserve the rights of the United States we do not even impliedly sanction the intimation contained in the opinion of the court below that under the decision in *Hardin* v. *Jordan* (140 U. S., 371), although on nonnavigable waters, riparian rights were not conferred by the State law, nevertheless the land beyond the banks passed

> to the States in virtue of the patents of the United States to the lot owners. Upon that question we express no opinion.

The holding of this court is contained in the following paragraph of the opinion (pp. 515 and 516):

> Our conclusion, therefore, is that by the law of Nebraska as interpreted by its highest court, the riparian proprietors are the owners of the bed of a stream to the center of the channel; that the Government, as original proprietor, has the right to survey and sell any lands, including islands in a river or other body of water; that if it omits to survey an island in a stream and refuses, when its attention is called to the matter, to make any survey thereof, no citizen can overrule the action of the Department, assume that the island ought to have been surveyed, and proceed to occupy it for the purposes of homestead or preemption entry. In such a case the rights of riparian proprietors are to be preferred to the claims of the settlers.

As stated by the late Judge Gresham in *State of Indiana* v. *Milk* (11 Fed. Rep., 389), there is a distinction between streams and lakes or ponds, and because of such distinction there is good reason for not applying the rule governing the ownership of lands bordering on the latter to lands bordering on the former. In this connection he said (p. 395):

> Nonnavigable streams are usually narrow, and the lines of riparian owners can be extended into them at right angles without interference or confusion, and without serious injustice to anyone. It was therefore natural,

when such streams were called for as boundaries, to hold that the real line between opposite shore owners was the thread of the current. The rights of the riparian proprietors in the bed of the stream and in the stream itself, were thus clearly defined, but when this rule is attempted to be applied to lakes and ponds, practical difficulties are encountered. They have no current, and being more or less circular, it would hardly be possible to run the boundary lines beyond the water's edge, so as to define the rights of shore owners in the beds.

Mr. Justice Brewer, in a dissenting opinion in *Hardin* v. *Jordan*, (140 U. S., 371, 404, 405) which was concurred in by Mr. Justice Gray and Mr. Justice Brown, quotes and apparently approves the following from an Illinois case:

> Indeed, the controlling distinction between a stream and a pond or lake is, that in the one case the water has a natural motion—a current—while in the other the water is, in its natural state, substantially at rest. And this is so, independent of the size of the one or the other. The flowing rivulet of but a few inches in width is a stream as certainly as the Mississippi. And when lands are granted by the proprietor of both land and stream, bounding such grant upon the stream, the grantee acquires right and title to the thread or middle of the stream. This right is grounded upon the presumption that the grantor, by making the stream the boundary, intended his grantee to take to the

> middle of the stream; and this presumption will prevail until a contrary intent is made to appear.

While it would seem that the reason so clearly stated in the above quotation for not extending the doctrine announced in *Hardin* v. *Jordan* to the lands between the meandered lines of a nonnavigable stream was not sustained in *Grand Rapids & Indiana Railroad Company* v. *Butler* (159 U. S., 87) *supra*, yet, as heretofore stated, that case involved the ownership of an island in a stream which was shown to have been navigable when meandered.

(*5*) *Should the doctrine announced in Hardin v. Jordan be held to apply to lands between the meandered lines of a nonnavigable stream, the title to the bed of the Arkansas River in Kansas would not be vested in the State.*

From the brief of counsel for complainant it would appear that in only two cases has this question been in any manner discussed by the Supreme Court of Kansas, viz: *Wood* v. *Fowler* (26 Kans., 682) and *Steinbuchel* v. *Lane* (59 Kans., 7). *Wood* v. *Fowler* has already been referred to. In that case the Supreme Court held, in effect, that the title to the bed of a navigable stream is in the State. In *Steinbuchel* v. *Lane* the same court held, in effect, that the title to an island within the Arkansas River in the city of Wichita, opposite the mouth of the Little Arkansas River, and between the meandered lines, did not pass from the United States by patent issued to homestead claimants for the lands opposite the said island, and that

title to said island remained in the United States. Further, that such patentees took title to the thread of that part of the stream on which their lands bordered, opposite the island, and not to the center of the lands between meandered lines, which was near the center of the island in dispute. Further, that the United States had the right to survey said island and dispose of the same to a settler thereon under the homestead law, and that such settler had a complete and valid title thereto.

(6) *The Arkansas River in the State of Kansas never was navigable and can not be made so.*

Some of the evidence, but not all, in regard to the question of the navigability of the river is discussed by counsel for complainant in their brief, under section 6, pages 21, 22, 23. From that which they do discuss they make two deductions. The first is incorporated in the fifth statement of alleged probative facts (sec. 23, p. 184) and is as follows:

> Fifth. Prior to the destruction of the flow of the river, it was practically navigable to a point above Arkansas City, and, with a small amount of improvement, could have been made navigable during most of the year from Wichita to its mouth, affording cheap water communication to the sea.

The second deduction is found on page 190 of the brief and reads:

> At the time the Territory of Kansas was organized, at the time Kansas was admitted

> into the Union, and for many years thereafter, the Arkansas River within the State of Kansas was considered and treated by the United States Government and the State of Kansas as a navigable stream.

Neither of the above statements, as will be hereafter shown, it is submitted, is warranted by the evidence in the case, taken as a whole. However, before discussing the evidence upon this point, we will first call the attention of the court to the definition of a navigable river as announced in the case of *The Daniel Ball* (10 Wall., 557, 563) and approved in the following and other cases: *The Montello* (20 Wall., 430, 439); *Escanaba Company* v. *Chicago* (107 U. S., 678, 682); *Miller* v. *Mayor of New York* (109 U. S., 385, 395); *Packer* v. *Bird* (137 U. S., 661). This definition is as follows:

> Those rivers must be regarded as public navigable rivers in law which are navigable in fact. And they are navigable in fact when they are used, or are susceptible of being used, in their ordinary condition, as highways for commerce, over which trade and travel are or may be conducted in the customary modes of trade and travel on water. And they constitute navigable waters of the United States within the meaning of the acts of Congress in contradistinction from the navigable waters of the States when they form, in their ordinary condition by themselves, or by uniting with other waters, a continued highway over which commerce is or may be carried

on with other States or foreign countries in the customary modes in which such commerce is conducted by water.

In *Leovy* v. *United States* (177 U. S., 621) it was held (syllabus):

The term navigable waters of the United States has reference to commerce of a substantial and permanent character to be conducted thereon.

In Farnham on Waters, vol. 1, pp. 67, 68, it is stated: The mere capacity to permit passage in a boat of any size, however small, from one stream or rivulet to another, is not sufficient to constitute the former a navigable water of the United States unless the channel is substantially useful for some purpose of interstate commerce. * * * The question what is or what is not a public navigable stream is one not of local or statute but of general law. (Ib., p. 68, citing *Chisolm* v *Caines*, 67 Fed., 285.)

* * * *

The character of many streams is such that their navigable capacity is a matter of common knowledge, of which the courts will take judicial notice; but where the fact of navigability is disputed the question is to be solved by a jury. If the facts are found, the question whether or not the stream is navigable is for the court. The one who claims the stream to be navigable has the burden of proving that it is in fact susceptible to valuable use for commercial purposes in its natural state, unaided by artificial means and devices. (Ib., pp. 124, 125.)

In *Wood* v. *Fowler* (26 Kans., 682) the Supreme Court of that State, by Brewer, judge, now Associate Justice of this court, said:

> The better and more generally accepted rule in this country is to apply the term "navigable" to all the streams which are in fact navigable.

To support the statement that the United States considered and treated the river in Kansas as a navigable stream counsel for complainant rely upon the facts that the same was meandered, and that appropriations were made for its improvement between Fort Smith, Ark., and Wichita, Kans., in the year 1879 of $20,000 and in the year 1880 of $15,000, in 1881 of $24,000, and in 1882 of $35,000. (Kans. br., 21) (333–334.)

We have already shown that the meandering of a stream has no significance whatever. If anything is proved by the appropriations made by Congress it is that the river was not navigable in Kansas before these appropriations were made, otherwise there would have been no necessity for such appropriations; also that the river could not be made navigable for the reason that after said appropriations had been expended navigation was not conducted thereon in Kansas (333), and Congress ceased to expend any money in an attempt to make it navigable in that State. How and why the appropriations were obtained from Congress for expenditure in Kansas, and the effect such expenditure had in regard to making the river therein navigable, are

fully explained by M. M. Murdock, complainant's first witness, who has resided at Wichita since the spring of 1872, and who has been the editor and proprietor of the *Wichita Eagle* since that time. He testified, in effect, as follows (260):

> I was one of the fellows that started the appropriations for the Arkansas River, and we built boats out here. Senator Plumb and myself and one or two other fellows got up a scheme of running a fellow for Congress from Topeka for this district down here, a gerrymandered district, that I got through the State senate myself, to get the (261) support of the people down here for the fellows up there. The advocacy of the navigability of the Arkansas caught them. The freight rate schedules of the railroads of the present time are all based upon navigable waters. The running of steamboats up and down the river would give water rates for our wholesalers. Of course the engineers sent out here were told to keep in touch with me, because at that time I was quite a fellow here. One of these engineers assured me that there could be a channel put through from here down to Arkansas City sufficient for navigation with little boats. They built their boats here at Sankey's, on the channel. A fellow by the name of Walton built a flatboat at Arkansas City and put a saw-mill engine on it and some kind of a wheel, and started for Wichita. He got here within 10 or 12 miles and went back. That must have been in 1870. They built a number of boats here in the early days to haul

lumber down to Arkansas City. This was at the end of the railroad. There was no other road in this city. The Santa Fe came here and stopped. I didn't pay much attention to it, but I know they built some boats here, little flatboats, that came from Colorado down. They never carried on any commerce further than that. I don't know but there was some flour or something shipped down in the river flats. No boat ever got back that went down. They didn't go with that idea. The river was not navigable for any practical purpose after you folks commenced taking the water, and before that it was not, in my honest judgment, navigable for any practical purpose. Grant once said, when he was lieutenant in the Army, that the Arkansas River would be navigable from this city to its mouth if they would copper line it, and I guess he was about right, because I know how shifting those sands are.

That the United States does not, and for many years has not, regarded the Arkansas River in Kansas as a navigable stream, is emphasized by the fact, as shown by the evidence, that railroad and county bridges and dams have heretofore been erected across and in its bed with the knowledge of the United States, and have been maintained for at least a quarter of a century across the river at numerous points between Wichita and the Oklahoma line, and the right so to erect and maintain these bridges and dams has never been questioned by the Government under the act of September 19, 1890 (26 Stat., 454, sec. 10).

To support the statement that Kansas treated and considered the river as navigable in that State, counsel for complainant rely upon the negative fact that "its navigability has never been denied or questioned by any legislative act or judicial decision (Kans. br. 21), and, in this connection, say that the legislature of the State in 1864 declared certain other rivers not navigable, and authorized the bridging of the same; and that "on two different occasions the navigability of the river at Wichita was submitted to juries (1715), and in each case the jury found, as a matter of fact, that the river was navigable. One of these cases was appealed, and is the case of *Steinbuchel* v. *Lane*, (59 Kans., 7).

It is pertinent to inquire where the legislature of a State derives power to define what are and what are not navigable streams such as constitute avenues of interstate commerce. Counsel for complainant are silent upon that point. However, if it be conceded that the State of Kansas has such power, it does not follow that the failure to exercise the same in regard to any particular stream stamps that stream as navigable, if it is not navigable in fact.

It is shown in the opinion of the court in *Steinbuchel* v. *Lane*, (51 Pac. Rep., 886), that in that case the jury at Wichita, where the case was tried, found the river to be navigable there. That fact, however, was not binding upon the court. (Farnham on Waters, *supra*, 124.) There is no competent evidence in the record to show that any other jury of Wichita, or a jury at any other point, found any such fact. The

only evidence on this point was given by one J. R. Sites, a witness for defendants, and is found on pages 1714, 1715 of the abstract. A part of the Lanes Island referred to by this witness was the subject of the controversy in the case of *Steinbuchel* v. *Lane*, *supra*. This island embraced an area of about 26 acres and is opposite the mouth of the Little Arkansas River. It existed in 1867 at the time the public survey was extended over the public lands opposite the same by meandered lines then run. Lot 5, bordering on the river and north of the island, was patented to one Smith in 1873. Mary Norman settled on the island in 1875. On her application it was surveyed and patent for the same was issued to her by the United States in 1876. The plaintiff, who derived title from Smith, claimed a part of the island on the ground that the stream was not navigable, and that Smith's patent conveyed title to the middle of the stream, claiming that the middle thereof was the center of the island. "The defendant claimed title under a chain of conveyance from Mary Norman." As stated in the opinion at the time Smith obtained patent to lot 5, " the jury found under the testimony that the river was then navigable, although it has now ceased to be so."

In regard to this finding, the court said, among other things (51 Pac. Rep., 887):

> As we view the case, it is unimportant whether the river was navigable or not. * * * But, whether that finding be right or wrong, it appears without dispute that in 1869, when

> Smith settled on his land, the island contained about 26 acres; that the waters of the Arkansas River divided at the head of the island, forming two distinct channels, the one on the north of the island being about 200 feet wide and the one on the south about 300 feet wide.

Further along the court says:

> In this case * * * the question is, what was the boundary of the land patented to Smith? Was it the north bank of the river, the center line of the north channel, the center line of the south channel, or, as seems to be claimed by the plaintiffs in error, a line running midway between the north and south banks, dividing the island into two parts, making the thread of the stream extend across dry land and over primitive soil.

In answer to this question the court says:

> We think, at most, the plaintiff's boundary extends only to the middle thread of the north channel of the river.

In its facts, this case is almost identical with the facts in the case of *Whitaker* v. *McBride* (197 U. S., 510), except that in this case the application of the settler upon the island to have the lands surveyed by the Government and patented under the homestead law was allowed, while in the case of *Whitaker* v. *McBride* the application of the settler to have the island surveyed was not allowed.

To support the statement that the river at Wichita, Kans., was formerly navigable in fact counsel for com-

plainant in their brief, at page 21, rely upon and refer to the testimony of M. M. Murdock (267), and J. R. Mead (2139). At the page referred to Mr. Murdock testified with regard to this matter as follows: "It is my recollection that flour and lumber were shipped down the river." This same witness, however, as appears on page 261 of the abstract, testified as follows: "I don't know but there was some flour or something shipped down in the river flats. No boat ever got back that went down. They didn't go with that idea." As has been heretofore shown, this witness also explained why certain boats were built at Wichita.

Mr. J. R. Mead was called by complainant in rebuttal. He testified on the point under consideration, in substance, as follows: (2139) That in 1872 there was a steamboat built at Wichita which ran from Douglas avenue about a mile and a half downstream during high water to an island where they had picnics; that he saw some boats built at Wichita; that he heard that one of the boats went down to Florida; that he saw house boats of considerable size by which parties went down the river to Arkansas and that he saw a boat which he was told came from Pueblo down to Wichita, and that there were small boats at the end of the bridge for local use.

It is respectfully submitted that the evidence of Mr. Mead referred to does not bring the Arkansas River within the definition of a navigable stream as such definition has been set forth by this court. It will be noticed also that Mr. Mead does not say

that any boat which ever made a voyage below Wichita was ever known to return.

Outside of certain descriptive and historical writings there was no evidence offered by complainant in respect to the practical navigability of the river between Arkansas City and Wichita. There was some oral evidence submitted by complainant showing that some small craft had occasionally been seen on the river and that it was navigable as far up as Wichita. The principal witness introduced by complainant in respect to navigability was I. H. Bonsall (383). He testified, in effect, that a steamer 120 feet long, called the *Aunt Sally*, made a trip from Little Rock to Arkansas City in the summer of 1878. The intervenor called as a witness David D. Chapman (1304), captain of the *Aunt Sally* when she made the trip referred to by Mr. Bonsall, and who had been engaged in plying the Arkansas River as a boatman for about forty years. In regard to the trip to Arkansas City by the *Aunt Sally* he testified, in effect, as follows:

> I was captain of that boat. The inducement that was offered me to take that boat to Arkansas City was that there was said to be $700 for the first boat that would make the trip, and so, taking this boat, I went there to get that, and it was a kind of experiment. I didn't get the money. I had some little difficulty in getting back. We were fifteen days going up there from Little Rock and twelve days, about, in getting back.

On page 1305 he says that in going up they ran

only in the daytime and laid up at night; that in coming down they went with the current. On page 1306 he says: "That boat drew two feet of water when loaded. We had no load coming down. The reason was the river was falling very fast and I knew enough about the Arkansas River to know that if I didn't get out then I wouldn't get out, and I had my boat up there and wanted to get away. We were offered to have a load given us if we would carry it out, but I didn't want it. I wouldn't take it." On page 1307 he says, in effect, that at Arkansas City there had been a flood in the river just previous and that they found plenty of water to run up and down the river for several miles, and that they remained there six days.

As stated by counsel for complainant in their brief, page 21, there was some evidence in regard to a boat called the *Cherokee*, and another called the *Kansas Millers*, and another by the name of *Nonesuch*, and that these boats attempted to navigate the river for commercial purposes below Arkansas City, but it was not shown that any of them were successful.

(7) *The testimony submitted by the intervenor shows conclusively that the Arkansas River never was and can not be made practically navigable above Fort Gibson, in Indian Territory.*

It will be noticed that none of the witnesses for the complainant who gave testimony regarding the navigability of the river in Kansas possessed any practical or expert knowledge on the subject, while,

as will be hereafter shown, all the witnesses called by the intervenor who testify in regard to this question were men of practical experience in the navigation of boats on said river, or were Government officers and engineers whose duty it was to make a study of the question of the navigability of said stream. Edwin Huston, a witness for the intervenor, testified, among other things, in effect (1300), that he was 65 years of age, that he had resided at Little Rock, Ark., for about forty years and had been engaged in boating on the Arkansas River from its mouth to Fort Gibson since the year 1855; that the latter point had always been considered the head of navigation; that he believed that boats do run up as far as Fort Gibson at the present time. L. P. Drake, a witness for the intervenor, testified, among other things (1298), that he had been living at Little Rock, Ark., off and on since 1855; had done a good deal of boating on the Arkansas River, beginning in 1855, and ceased five or six years ago; had been as high up the river as Fort Gibson with boats; that between Fort Smith, Ark., and Fort Gibson, Ind. T., the river was not navigable generally in the summer or even in the fall. David D. Chapman, a witness already referred to, and called by the intervenor, says that Fort Gibson was considered the head of navigation when he first began to ply the river in 1855, and that he would not consider the river navigable above Fort Gibson. This witness further states (1308):

> To sum it all up, the Arkansas River is a river of shifting sands and varying depths of

> water * * * and always will be as long as time extends. I don't think there is money enough in the United States Treasury to make this river navigable the year around under any conditions.

William L. Sibert, major of the Corps of Engineers of the United States Army and a graduate of West Point in the class of 1884, was called by the intervenor and testified as follows: That he was stationed at Little Rock from 1894 to 1898 in the district known as the Little Rock district, embracing the Arkansas and White rivers, and other rivers in that section; that in the discharge of his duties it was necessary in the formation of plans for the improvement of the Arkansas River to ascertain as fully as possible the low and high water discharges and the physical conditions that would affect navigation; that while he was at Little Rock, navigation extended from some points between Fort Smith and Fort Gibson to its mouth; that small boats never went farther than Fort Gibson, if they went that far.

(*8*) *To hold that the State is the owner of the lands of the Arkansas river would cause uncertainty and confusion in regard to the title to lands bordering on the river.*

It is shown by the evidence, and it is a fact of which the court will take judicial notice, that the Arkansas River in Kansas is a stream of changing current and shifting bed, and that in times of excessive or even of moderate high water, the current cuts

in on one bank and carries the soil to the other bank or forms islands in the center of the stream, thus decreasing the area of a riparian owner on one side and adding to the area of the riparian owner on the other side. The islands thus formed in the center of the stream often become attached to the mainland. At various places along the river the farms of riparian owners have been increased in this manner by many acres. As illustrative of this characteristic of the river and its effect in respect to riparian lands, reference is made to the testimony of E. E. Frizell, a witness for Colorado (1565, 1566). He testified at Larned, the county seat of Pawnee County, and his testimony was taken at the court-house. On cross-examination by counsel for the intervenor, he testified as follows (1565, 1566):

> The building we are now in, the court-house of Pawnee County, is on the north side of the river. Out south from here to the river it is a little over half a mile. Opposite here the river runs directly east. It bears a little bit to the south; just a little. The channel of the river used to be in the first bottom, up the valley seven or eight miles. There were some places there would appear to be some old channels that now might be termed first bottom, on the north side of the river, about two or three hundred feet from the present channel of the river. Apparently, there have been channels there. No; it is not the tendency along the line of the river to have accretions on the north side and to cut out on the south bank of river all along. I gained sixty acres of land on the south side on a

> single quarter, and I gained 200 on the other side. Not directly opposite; no, sir. When I gained the 200 acres on that side of the river nobody lost it on the other side, as I got the island that was in the river. Yes, sir; the tendency of the river is to shift from one side to the other according to how the river runs.

Other witnesses testify in substance to the same effect. From such testimony it is apparent that if the State owns the land between the meandered lines as the river existed when the said lines were made, it now has title in many places to portions of many farms which border on the present channel of the river.

It is a fact, of which the court will take judicial notice, that there are a number of nonnavigable meandered streams in the western part of the country which possess the same characteristic as is possessed by the Arkansas River with regard to changing channel and shifting bed, among them being the Rio Grande, the Colorado, the North Platte, and the South Platte. In view of this peculiar characteristic of these rivers, the question how far a grant of land bordering on such stream extends—whether to the center of the channel, as the same existed when the river was meandered, or to the meandered line, or to the water's edge—is becoming very important to the respective owners of such lands bordering on such stream and is now quite acute before the Land Department. In view of the recent decision of this court in *Whitaker* v. *McBride, supra*, the necessity

for a definite ruling on this question is apparent. In this connection it is respectfully submitted that the only practicable and safe rule is the one suggested in *Railroad Co.* v. *Schurmeir*, to the effect thate the Government grantees of public land bordering on a nonnavigable river take to the center of the channel of the stream as such channel existed at the time the lands were surveyed. Such a rule is consistent with and supported by the principles of the common law and is in accord with the declaration of Congress upon the subject, found in sec. 2476 of the Revised Statutes, which reads as follows:

> All navigable rivers within the territory occupied by the public lands shall remain and be deemed public highways; and in all cases where the opposite banks of any streams not navigable belong to different persons the stream and the bed thereof shall become common to both.

(9) *The navigable capacity of the Arkansas River has not been interfered with by the alleged acts of the defendants; hence no duty devolves upon the intervenor to aid complainant to secure relief upon the ground that such acts tend to destroy the navigable capacity of said stream.*

Counsel for complainant, at page 23 of their brief, ingeniously suggest that it is incumbent upon the Government to aid complainant in securing the relief asked, as appears by the following language:

> The complainant in this case may not be in a position to complain of the destruction of the

> navigability of an inter-state stream which is under the control of the United States Government, but the complainant has not deemed it improper to present these facts to the court, leaving the protection of navigable streams to the United States Government, where it properly belongs.

Manifestly, this suggestion was prompted by the decision of this court in the case of *United States* v. *Rio Grande Dam and Irrigation Company* (174 U. S., 690), wherein it was held, in effect, that under then existing acts of Congress a State could not appropriate all the waters of tributary streams which unite into a navigable water course if such appropriations destroyed the navigability of such water course, and that, in the event a State threatened to make such appropriations, proper proceedings in equity might be instituted under the direction of the Attorney-General.

That case was heard and decided only a few years ago, but yet at a time when the waters of nonnavigable streams in the arid region were still generally considered as of greater value and of more importance for the purpose of navigation at the point where such streams, uniting with others, formed a navigable water course, than for the purpose of irrigation where such streams were not navigable.

Even Mr. Kinney, in his work or "Irrigation," published in 1894, practically conceded this. (See p. 57.)

Since the date of the decision last cited (May, 1898) the importance of certain western rivers as avenues

of communication between the States has been constantly declining, while the use of the waters of streams for irrigation purposes has grown in importance. This is clearly shown by the evidence and by public acts and documents, reference to which will hereafter be made.

In speaking of the waters of the Missouri River in North Dakota, Senator Hansbrough, United States Senator from that State, a witness introduced in behalf of intervenor, among other things, said, in effect (1210), that it would be wise for the Government to purchase all the steamboats on that part of the Missouri River in North Dakota and prohibit navigation thereon, devoting the waters of the river entirely to the irrigation of arid lands in said State. At page 1213 he says, in effect, that navigation on the Missouri River in North Dakota is of small consequence in comparison with the advantages of irrigation.

F. H. Newell, Chief Engineer of the Reclamation Service, another witness for intervenor, at page 1283, says:

> The vital and highest need throughout the western two-fifths of the United States is to take all the waters from the rivers and utilize them, consuming them in agriculture, whether the streams are navigable or unnavigable, all waters of any kind. The question of the navigation of streams in the United States has become much less important within the last twenty-five years. Very much. And the tendency of Congress, as shown by recent legislation, is to give the Reclamation Service

> the right to divert waters from the rivers which up to the present time have been considered navigable, such as the Colorado and Yellowstone.

Elwood Mead, Chief of the Irrigation and Drainage Investigations of the Department of Agriculture, at page 1387, says:

> The use of water for household and domestic purposes I would put as of primary importance. After that, irrigation. I would put irrigation even ahead of its use for power where its use for power would prevent its being used for irrigation, because you can provide your power in some other way and you can not provide food in any other way. I would put irrigation as superior to navigation, because of the far greater value that you can get out of the water, and because navigation is the one instance of the use of water where its importance instead of increasing is diminishing.

Without at this time questioning the doctrine laid down in the *Rio Grande* case, it is respectfully suggested that in view of the decision of this Court in *South Carolina* v. *Georgia et al.* (93 U. S., 4, 13), that Congress has "the power to determine what shall or what shall not be deemed, in the judgment of the law, an obstruction of navigation," and the intimation contained in that and other decisions of this court to the effect that Congress may have the power to impede or destroy the navigability of a stream if the general welfare demands the exercise of the power; and in view of the policy of the Government in respect to the

reclamation of arid lands as manifested by recent Congressional legislation, by the decisions of this court, and by Executive acts and messages, all of which will be more fully referred to hereafter, it would seem to be questionable whether an action would now lie on behalf of the Government to restrain acts such as are alleged and complained of by the State of Kansas upon the ground that they tend to destroy the navigability of the Arkansas River.

But even though it be conceded that the right of the Government to bring such an action were clear, the exercise of the right would be of doubtful propriety in view of the undisputed evidence in the case in respect to the importance of the use of the waters of the river for navigation as compared with the importance of such use in Colorado, and Kansas as well, for irrigation purposes.

As shown by intervenor's Exhibit No. 2, introduced in evidence in connection with the testimony of P. R. Van Frank, jr. (1310), and which for convenience of reference is here inserted, but 15 vessels, light craft, navigated the Arkansas River from May 31, 1903, to June 1, 1904; that the total tonnage carried was 92,041, of the estimated value of $2,079,893; that the total number of passengers carried was

17,787, of which 14,472 were on excursion trips. This exhibit is as follows:

List of vessels that navigated Arkansas River from May 31, 1903, to June 1, 1904.

Name.	Net tonnage.	Draft loaded.		Between—	Round trips.	Passengers.
		Steamer.	Barges.			
		Ft. in.	*Ft. in.*			
Quickstep	66	3 0	3 6	Arkansas City and Garland Lake.	68	1,000
Thurman	16	1 6	3 0	Little Rock and Perryville	16	.....
Roan	39	2 0	.....	Rafting out of lower river to Arkansas City.	(?)	.....
Victoria	12	2 6	.....	do	10	.....
Hazel Rice	138	3 6	6 0	Helena and Smith Cut-off	10	.....
J. N. Harbin	266	3 0	.....	Memphis and Victoria	1	964
				Memphis and Swan Lake	3	
				Memphis and Pine Bluff	22	
Lucile Nowland	298	5 0	.....	do	25	578
Delta	571	6 6	.....	Memphis and Little Rock	1	220
A. D. Allen	67	4 0	.....	Little Rock and Pine Bluff	30	280
				Little Rock and Littles	1	4
Dardanelle	164	3 6	3 0	Little Rock and Pine Bluff	10	255
				Little Rock and Cardens Bottoms	10	
				Excursion trips	44	8,800
Henry Sheldon	220	3 6	.....	Little Rock and Shoal Creek	2	14
				Little Rock and Cardens Bottoms	6	
				Excursion trips	23	5,673
				Little Rock and Pine Bluff	12	.....
Mary D.	40	2 6	.....	Fort Smith and Webbers Falls	15	.....
Nettie	64	2 0	3 0	Towing to Garland Lake	(?)	.....
Wash Honshell	135	3 6	6 0	Cairo and Smith Cut-off	4	.....
Climax	(?)	3 0	.....	Rafting out of lower river to Arkansas City.	28	.....

Classification of commerce reported, year ending May 31, 1904.

Articles.	Tons.	Articles.	Tons.
Cotton	2,652	Railway ties	3,333
Cotton seed	5,025	Crushed rock	3,564
Grain	3,516	Square timber	1,300
Lumber	2,273	Gravel	3,498
Provisions	3,088	Miscellaneous freights	4,503
Saw logs	51,020		
Staves	6,149	Total tonnage reported	92,041
Cement	2,060	Estimated value	$2,079,960

Seven hundred and fifty cubic feet of water per second of time (which is the highest possible claim as to the quantity of water which would enter the State of Kansas if undiverted) would raise the river at Wichita, where it is 500 feet wide, about two inches, and where the river is about 1,000 feet wide about one inch (645). This amount at Little Rock

would not raise the water in the river one-tenth of a foot (1820), and for purposes of navigation such an amount would not be noticed at Little Rock (1311–1312).

Louis G. Carpenter testifies that within the State of Colorado, in 1902, from the waters of the Arkansas River and its tributaries there were irrigated 300,115 acres of land (654); that the average acreage irrigated from 1895 to 1904, inclusive, is 312,287 acres (1821); that the value of the farm products of these lands in 1900 was $6,442,464 (657); that no part of said irrigated land can be purchased for less than $30 an acre; that some of it would run in value as high as $800 to $1,000 an acre; that the average value of said land was from $60 to $75 an acre (655); that without irrigation these lands would not be valuable for agriculture and would only be worth the Government price of $1.25 per acre (655); and that the irrigation of these lands is the absolute foundation of the prosperity of the whole community (657).

Elwood Mead, a witness for the intervenor, says (1373) that the total number of acres irrigated in the Arkansas Valley in Colorado in 1904 was 345,175 acres; that the average return in crops for 1904 from eight canals in the valley of the Arkansas River in Colorado was $24.68 per acre; that the average crop value for each acre-foot of water in 1904 was $9.17 (1377); that the lands so producing crops would not be worth more than $2.50 per acre without water, but with water for irrigation they are worth from $100 to $500 an acre; that the total

discharge in acre-feet of the Arkansas River in Colorado for the months of May, June, July, August, and September for the years 1901, 1902, and 1903 at Salida and Pueblo was as follows (1375, 1376):

AT SALIDA.

1901	245,000
1902	117,000
1903	323,000

AT PUEBLO.

1901	384,000
1902	137,000
1903	324,000

Salida is 45 miles above Canon City. At Canon City the river emerges from the mountains. Pueblo is 40 miles below Canon City and between these two points there are several thousand acres irrigated from the waters of the river.

The mean annual divertible flow of the Arkansas River in Colorado in cubic feet per second, as shown by Bulletin No. 140, introduced in connection with the testimony of Mr. Mead (1396), is as follows:

January	660	July	3,250
February	700	August	1,100
March	800	September	700
April	1,030	October	680
May	2,630	November	720
June	4,370	December	720

A glance at intervenor's exhibit No. 2, which shows the importance of the waters of the Arkansas River for navigation, and at the figures submitted by Mr. Carpenter and Mr. Mead with respect to the importance of the waters of said river in Colorado for irrigation purposes, shows that said waters for the latter purpose are of im-

measurably greater importance than for the purposes of commerce between the States. There are other and better avenues of State or interstate commerce in the Arkansas Valley than that of the Arkansas River, but there are no means, outside of the using of the waters of the Arkansas River and its tributaries in Colorado, by which the arid lands in said valley in Colorado can be made productive and capable of sustaining human life.

The only benefit which could possibly be derived from the use of the 750 cubic feet of water in the Arkansas River in Colorado for navigation purposes, even though it be conceded that the entire volume, if undiverted in Colorado, would reach Fort Gibson, would be slightly cheaper freight rates. Can it be successfully contended that the difference in cost between rail and natural water carriage along that part of the Arkansas River where it is navigable would compensate for the enormous loss in Colorado which would result if the use of the waters of the stream therein for irrigation purposes should be enjoined? Would not the application of any principle with respect to the waters of the Arkansas River giving navigation priority over irrigation be a great injustice to the State of Colorado and her citizens; a much greater injustice than the extreme claim of injury to the complainant would be to Kansas and her citizens?

But should the Government insist, as suggested by counsel for complainant, that a decree be entered restraining the diversion of the waters of the Arkansas

River for irrigation purposes upon the ground that the waters of said stream are necessary to maintain the navigable capacity of the river below, and by such insistence secure such a decree, what would be the fate of the western Kansas irrigating ditches which counsel for complainant seem so anxious to protect, in which there has been invested $600,000 and which have a capacity of 600 to 700 cubic feet of water per second of time and are capable of irrigating 245,000 acres of land? (Kans. br., 109.) And it may also be asked, What would become of the lands which have been reclaimed and are now cultivated by the waters conducted thereon by said ditches? (See testimony of Henry Block, 1454–5–6; D. E. Hogbin, 1469–70; B. F. Stocks, 1475–1480, 1483.)

(10) *The diversion and use of the waters of the river and its tributaries in Colorado do not interfere with the navigable capacity of the stream.*

The court says in *United States* v. *Rio Grande Dam and Reservoir Company* (174 U. S., 690, 709):

> It does not follow that the courts would be justified in sustaining any proceeding by the Attorney-General to restrain any appropriation of the upper waters of a navigable stream. The question always is one of fact, whether such appropriation substantially interferes with the navigable capacity within the limits where navigation is a recognized fact.

As has been heretofore seen, the evidence shows that navigation on the Arkansas River is not a recog-

nized fact above Fort Gibson. The evidence also shows that the appropriation and use of the waters of the river and its tributaries in Colorado do not interfere with navigation at the point where navigation is a recognized fact. The evidence upon this point is as follows:

William L. Sibert, major in the Engineer Corps of the United States Army, a graduate of West Point in the class of 1884, who had been stationed at Little Rock, Ark., from 1894 to 1898 as engineer in charge of the improvement of the Arkansas and White rivers in the district known as the Little Rock district (1295), among other things says, in effect, that while at Little Rock he made a study with respect to the effect that irrigation from the waters of the Arkansas River in Colorado and in Kansas had on the navigability of the river; that from his study and observation, which included the examination of the records and history in regard to the water discharge of the Arkansas River, he could not establish the fact that the low-water discharge of the Arkansas River, where navigable, was decreased in consequence of irrigation; that from his observation he was of the opinion that the stages of the Arkansas River, in its navigable portion, are almost determined by the rainfall from points in Kansas down to the mouth of the stream; that he had been directed by the Secretary of War to investigate and make a report with respect to the effect irrigation upon the upper reaches of the Arkansas River had upon navigation, and that in response to such direction he made an investigation and made

a report thereof, which report is dated April 21, 1898 (1296); that in making that report he could not establish the fact that there had been any diminution of the flow in consequence of irrigation, and that he did not discover anything in regard to the flow of the Arkansas River west of the Colorado-Kansas line that would materially affect the navigability of that portion of the stream that was considered navigable (1297); that from his investigation and reading of historical records his conclusion was that the low-water stage is no less now than it was prior to the time when they began to irrigate the lands in Colorado from the waters of the Arkansas River (1298).

P. R. Van Frank, jr., civil engineer for the War Department, stationed at Little Rock, Ark., who had occupied that position for twelve years, testified, among other things, in effect, that from investigations made by him in 1898 he could not find that the taking out of the water of the Arkansas River for irrigation in Colorado had any effect upon the flow of the river at Fort Gibson and below; that he could not find any records that would prove that such was the case; that he had made a thorough investigation, had interviewed old citizens and examined historical documents; that since 1898 he had continued his investigations with respect to the volume of water in the Arkansas River at Fort Gibson and could not say that there was any appreciable decrease in the flow thereof from Fort Gibson to its mouth (1309); that the taking out of water above Wichita, Kans., at the ordinary stage of the river would not be noticed at

Little Rock; that the taking of water out of the stream at a point above Wichita in the ordinary stages of the river might have an appreciable effect in the vicinity of Fort Gibson; that if the low water of the Arkansas River were taken out above Wichita it would not affect the low-water flow of the river at Fort Gibson (1310).

L. P. Drake, who had been living in Little Rock for thirty years and who had been engaged in boating on the river from 1855 until within six or seven years, stated that in his opinion the volume of the water in the Arkansas River was about the same (1298).

Edwin Huston, who had also been engaged in boating on the Arkansas River since 1855, between its mouth and Fort Gibson, stated, in effect, that there was no appreciable difference in the volume of the river now from what it was formerly (1300).

To the same effect was the testimony of David D. Chapman, who had been plying the Arkansas River as a boatman for forty years (1304).

IV.

THE RECLAMATION AND CULTIVATION OF THE ARID LANDS BELONGING TO THE GOVERNMENT IS INDISPENSABLE TO THE FUTURE GROWTH AND PROSPERITY OF THE NATION.

While counsel for the intervenor appreciate that by fiction of law the court is presumed to know, judicially, many of the features of this case, and especially those in regard to the arid public lands, their situation, their extent, their present condition and their possibilities by irrigation, yet they deemed it proper to

submit evidence in respect to these and other features of the case, and thus, to a certain extent, relieve the court of the labor of ascertaining facts which might be necessary to render the fiction of law a reality.

A fact of which the court will take judicial notice, but in respect to which no direct evidence was submitted, is that practically all that part of the public domain where the natural precipitation is sufficient to produce crops has been disposed of.

The correlative fact of which the court will take judicial notice, and in respect to which some evidence was offered, is that the undisposed-of public domain, consisting of many millions of acres, lies within that part of the United States where the natural precipitation is insufficient to produce crops.

This arid land is fertile if moisture could be applied to it, but is valueless and barren without moisture.

Another fact of which the court will take judicial notice is that the population of the country is growing rapidly and that the consumption of food and other supplies is steadily increasing per capita, thus making new and additional demands to supply the wants of hunger, for clothing, and for shelter.

It is common knowledge, deduced from ordinary observation, from practical experience, and from scientific investigation (see chapter on "Maintenance of the Soil" in the work of Nathaniel Southgate Shaler, Professor of Geology in Harvard University, entitled "Man and the Earth," 1905, pp. 73, 74, and 120, et seq.) that tillage and cultivation expose the soil

to the destructive action of rains, and that the crops take out soluble minerals more rapidly than they are restored. The impoverishment of the soil by tillage and by cultivation is going on everywhere except in a few flat regions in England and Belgium, and this impoverishment is already apparent in this country as far west as the Mississippi Valley, and is distressingly apparent in the European countries, notably Italy, Greece, and Spain. The food supply is already a matter of serious import, and by reason of the steady growth in population the world will soon be near the food limit, unless there is a decrease in the birth rate or additional areas are added to the tillable lands. This additional area can only be had by drainage and by irrigation. In this connection Farnham, in his work entitled "Waters and Water Rights" vol. 3, at page 1895a, says:

> The facts all seem to point to one conclusion, and that is that the agriculture of the future must, if the population of the world continues to increase, be rescued from a precarious dependence upon natural rainfall and be brought under the influence of a certain and controlled water supply.

It is not only a patent but a lamentable fact that the timber supply of the country, which is the chief element essential to shelter, and without which neither agriculture, horticulture, mining, manufacture nor any other interest can long survive, is rapidly becoming exhausted.

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To satisfy the increasing demand in this country for food, clothing, and shelter it is apparent that sooner or later resort must be had to the possibilities of the arid lands, and it is also apparent that these lands can be depended upon to supply such demand only when brought under cultivation, and they can be brought under cultivation only by means of irrigation.

(1) THE POSSIBILITIES OF THE PUBLIC ARID LANDS, AND THE NECESSITY FOR THEIR RECLAMATION.

F. H. Newell, Chief Engineer of the Reclamation Service of the United States Geological Survey, who has been connected with that Service since October, 1888, among other things says, in effect (1266):

> Since being connected with the Geological Survey I have paid particular attention to the possibilities of the arid region in this country. Since 1894 much of my time has been given to the study of the extent to which the arid region might be reclaimed by large hydraulic works, and I have spent most of my time in traveling, investigating possible reservoir sites, mountain waters, the present works already constructed, and the arid areas which might be reclaimed by full development. I think I have visited nearly every county in every State and Territory of the arid region. The arid region is that region where the rainfall is less than 20 inches per year, but it is better defined as the region in which the ordinary commercial crops, as we now know them, can not be produced habitually without the use of the artificial application of water. As such it

would extend from about the one hundred and second meridian in Kansas westward to the Pacific coast, excepting the wet area of western Oregon and Washington. Up to the present time, as shown by the census investigations, there have been irrigated upwards of ten million acres within the arid region, and a population of approximately three million persons is dependent upon them. It is probable that by complete storage of all the flood waters, by pumping water from underground, and by the most thorough application of water to the soil, upwards of fifty or sixty million acres may ultimately be reclaimed, and if that is done within the next generation or century, it will probably result in a population of one person to two acres irrigated; or one person to 1 acre irrigated, or, roughly, fifty millions of people may be supported in addition to the number now within the arid region. This land in its present condition is almost valueless. It has a price of $1.25 an acre as a rule, and much of it is not worth that. Under intensive cultivation and thorough irrigation, with an added population such as we may expect, the land should rise to upwards of $100 an acre, and under favorable climatic conditions it may rise to several hundred dollars an acre; that is, under the best conditions and moderate temperatures.

Again, on page 1273:

I have taken great interest in forestry and in forest protection, and have been Secretary of the American Forestry Association for a

number of years, and have also served on a commission appointed by the President, consisting of the Commissioner of the General Land Office, Mr. Richards, and the Chief Forester, Mr. Pinchot, and myself, to study the whole question of public lands for the Administration, and in connection with that the questions of forest preservation and their effect on the stream flow. It is believed that the forested area can be increased by adequate protection, occasionally by planting, and by a proper use, so that the right timber is removed and the young growth allowed to remain, and that a considerable extension of forests is not only feasible but necessary. Forestry aids irrigation, as the forest areas are those near the headwaters of a stream, where the land has practically no value for agriculture.

Elwood Mead, Chief of the Irrigation and Drainage Investigations of the Office of Experiment Stations of the Department of Agriculture of the United States, who for twenty years has given his exclusive attention to the subject of irrigation, including the engineering side and the agricultural and economic features (1363), says, on direct examination, among other things (1387):

> There are something over ten million acres of irrigated land in the arid region of the United States, and there is approximately invested in irrigation works in the United States $200,000,000. The population that this irrigated land supports amounts to many millions. It not only involves the people who live on the

lands and irrigate them, but cities are supplied with cheap and abundant food supplies from the cultivation of those lands, and manufacturing interests could not exist without their cultivation. I have made some investigation in regard to the amount of lands which can be added to the irrigated area by intelligent and proper use of the waters of the arid region, supplemented by flood waters in the shape of reservoirs and storage dams. I think it would not exceed ten per cent of the total area of the arid region, which would be something between sixty and one hundred million acres. In this estimate of ten per cent, I mean all the lands in the arid region which are irrigated now and which may be irrigated.

The arid region of the United States has usually been taken as all the territory from the ninety-seventh to the one hundredth meridian on the east to the humid lands on the Pacific coast; but that definition is not complete. There are portions of the country east of even the ninety-seventh meridian that are semiarid or do not always have an adequate water supply for the growing of crops without irrigation, and on the other hand there are scattered throughout the arid region isolated areas where crops can be successfully grown and are being grown from year to year without irrigation.

He further says, on page 1388, that the arid portion of the United States, including this country and the insular possessions, is between one-third and two-fifths.

On cross-examination by counsel for Colorado, Mr. Mead stated as follows (1409):

> The doctrine of appropriation in the United States has really had its growth and development in the arid region, and that was true because of the necessities of that part of the country. The right to appropriate and use water on the soil for irrigation in that part of the country which is called arid is not only desirable but it has been and is absolutely vital in the growth and development of that part of the United States, and is absolutely necessary to any creation of wealth in lands or to the support of any considerable number of people. It not only increases the number of people that are supported directly by the soil, but it makes possible the development of other industries by reason of furnishing the means of subsistence for those engaged in such other industries. It is also necessary in the border land between the arid and humid countries to carry out the fullest development of its possibilities. There is a large area of country lying between that which is truly arid and that which is truly humid that would support but a sparse population unless the amount of water which falls upon the soil was reenforced by the appropriation of the waters of the streams which go through the country. It not only increases production, but adds immensely to the comforts of life, so that it creates better conditions of life. I would say further in that direction that as population increases and agriculture becomes more intensive the desira-

bility of using streams for irrigation will extend to the humid country, just as it already has in the densely populated districts of the Old World, where we have larger sums expended for providing the water supply for irrigation in countries with a larger rainfall than that of the Mississippi Valley than are expended for providing water in this country for the arid region. There is no question but even in a humid country the population that could be supported could be greatly increased if the rainfall were reenforced by the use of the water from the streams as the country becomes densely populated. The market gardeners in the vicinity of eastern cities are providing a water supply for irrigation. It is becoming almost as universal where high-priced crops are grown and where a water supply can be procured as is provision for adding to the fertility of the soil in other ways. (Objection by complainant.) It is true in almost all parts of the United States known as the humid region that there are years when droughts occur and seriously affect the productiveness of the land. (Objection by complainant.) Yes, the provision of an irrigation system would have an effect in overcoming that. (Objection by complainant.) Two years ago we collected the results of the experience and gathered the opinions of a large number of irrigators along the Atlantic seaboard in a country with a rainfall varying from 30 to 50 inches, and in not a single instance did anyone who had irrigated express any intention of abandoning it, and in many

instances they said they based their entire profits upon the practice, and in some instances they said their profits had been increased four or five fold through the adoption of irrigation. It is difficult to generalize in regard to the difference in production of lands under irrigation and those not under irrigation in humid regions where the conditions are similar, because there may be seasons when no irrigation will be required; that is, there will be one season when irrigation will be of no benefit at all, and then there will be other seasons when the ability to apply water in irrigation means a difference between an abundant crop and a complete failure; and the advantages of irrigation are not measured alone by the increase in production, but by the fact that you are enabled to grow an abundant crop where there are general failures of that crop in the country not irrigated, and hence to command a much higher price because of that. The only large area where I have ever known of the statistics being gathered is in the irrigated region of Lombardy, where the department of agriculture of the Kingdom has gone to a considerable expense to gather over a series of years the results of farming by rainfall alone and by irrigation. There the average rainfall approximates forty inches, which is about that of the Mississippi Valley, and the results are about this—that the practice of irrigation doubles the population, doubles the taxable value of the property, and about trebles the crops produced. And that is in a humid country. The productiveness of an acre of

well-irrigated land in the arid region of the United States is considerably greater than that of an acre as nearly similar as possible in the humid region, and there is no question but that irrigated lands will support a larger population per acre by agriculture alone than will the humid country. They will support it because the conditions governing crop production are more largely under control. You can have a more scientific system of agriculture. You are not subject to the same vicissitudes; hence extensive farming is more profitable. And you also have a far wider range of products than is possible under rainfall, and our experience has already demonstrated that when it comes to growing high-price crops—products having a high acreage value—we are achieving a far greater success in the arid districts than in districts under rainfall alone.

George H. Maxwell, Chairman of the Executive Committee of the National Irrigation Association, says, among other things (1164–5):

In respect to the amount of land in the arid region which can be reclaimed by utilizing the waters of the streams there and by impounding the flood waters and using them, the Geological Survey has issued official reports in which the area is estimated at seventy-four million acres. I think Major Powell, when he was the Director of the Survey, thought it might reach one hundred million acres. My own idea is that if we assume there is a visible water supply to-day for seventy-four million acres, in the future we will find that that

amount will be doubled and trebled, and possibly even more, by the gradual enlargement of the area which will be brought under irrigation as the country develops, through return seepage and better methods of cultivation, which will show that less water is necessary, and, I think, in the planting of forests, which will serve to conserve the water and possibly increase the rainfall. I don't think it is possible to fix it absolutely; that is, as to the limit of possible development. I can illustrate that by the San Joaquin Valley. In the minds of the old settlers of that valley it was a hopeless desert. To-day in many parts of it it is a beautiful, irrigated country, and over large areas where originally the water table was from seventy-five to one hundred feet from the surface it is now so close to the surface that it is injurious to fruit and some of the crops they produce, and the question has become one of drainage rather than irrigation, and there is not a doubt but that there is water enough available to irrigate every acre of land in the Sacramento and San Joaquin valleys. Within fifty years I should say one hundred and fifty million acres can yet be reclaimed. Without regard to the possibility of its future irrigation, that land in its present condition is worth very little—perhaps $1.25 an acre. Some of it would not be worth that. If reclaimed by irrigation, the land would be worth all the way from $50 to $500 an acre.

In regard to the number of people this additional land when irrigated would support, I think the statistics of irrigated sections show

> that when an irrigated section of country with a reasonably moderate climate has been fully developed it sustains a population of from one to two per acre. I think it is safe always to estimate that if you have a certain number of acres of irrigable land, in the long run it will develop a population of that many souls; I mean directly and indirectly. For instance, if we have seventy-five million acres in sight with a visible water supply I think it would be safe to assume that in time it would support seventy-five million people. There is one qualification I want to be clear on there: That opinion as to population is of course based on the assumption that the irrigable lands are subdivided into farms of the smallest area that will support a family on each farm unit.

Louis G. Carpenter, State Engineer for the State of Colorado, who has studied irrigation problems since 1884 and who occupied the chair of irrigation engineer of the Agricultural College of Colorado (617), says, among other things, in effect (658–9):

> Nearly one-half of the total area of the United States lies within what may be called the arid region, a region which requires the irrigation of lands for the successful production of crops. If we take the limit of successful agriculture as twenty inches of rainfall, that would mean two-fifths, in round numbers, of the United States. Of course the term "successful agriculture" is a relative term, and with the rainfall above twenty inches—from twenty to twenty-five, or even more—agriculture be-

comes precarious. Droughts are long continued, crops may fail for a succession of years; that is, the margin of safety with the rainfall near the limit for successful agriculture is so small that it becomes very precarious and agriculture can not be called prosperous, even if it is not an absolute failure; and so the limit below twenty inches of rainfall, which is often taken, might be taken as the limit where agriculture is possible at all by ordinary methods of cultivation; and beyond that limit for some distance it would be so exceedingly precarious that it is very risky. This estimate is practically the same as that made by Major Powell in 1878.

Where water may be had for ample irrigation, irrigated lands will support a larger population per acre than nonirrigated lands. As a matter of common observation and knowledge of the tendencies of cultivation in the irrigated lands, we see as a matter of development that the methods adopted for irrigation are intensive methods; that the tendency is constantly to give more cultivation, to break up into small tracts and to obtain immediate and great returns from fertilizers, which irrigation makes it possible to do. We see that tendency has been developed in the Salt Lake Valley. It is developed in this State in the Cache la Poudre Valley and in portions of the Arkansas Valley. Where the unit is small the population is large, and this represents the tendency that is almost irresistible in the irrigated countries and not accidental or due to the peculiar position or location. It is also possible under such con-

ditions to multiply the number of crops, and one reason why the population may be greater and is greater under the successful irrigation method is that the certainty of crops becomes greater. The risk is less, and consequently the population can press closer upon the immediate means of subsistence than where the element of chance enters to a great extent. The same element enters in others countries, as in Egypt, which has been known from time immemorial as one of the most populous countries, in the portion which is irrigated. The portion which is irrigated in Egypt, and which constitutes Egypt for every intent and purpose except square miles, is not twice the irrigated section of Colorado. The populous valleys of the Tigris and Euphrates have been known from time immemorial. In the valley of the Po in Italy the population runs up to something like 700 per square mile as a whole. The tendencies for the past few years in various portions of the Cache la Poudre Valley in northern Colorado have been such as to break the land up into 5 or 10 acre tracts. Near Grand Junction, Colo., are similar illustrations. At Canon City, in the Arkansas Valley, people are living and thriving on tracts of but a few acres—2 or 3 acres—putting in immense amounts of labor and terracing the hillsides. So these conditions have already been reached in some portions of this new State, and they show tendencies, I think, that are continuous and need only the lapse of time and greater value of water and land to make them more evident all the way through.

Clarence T. Johnston, State Engineer of Wyoming, and who, in the study of irrigation problems, had visited each State and Territory within the arid region and had spent three months in Egypt engaged in preparing a report in respect to irrigation in that country (1022), says, among other things (1024):

> I have made some study of the effect of irrigation upon cultivated forestry. Forests can be successfully cultivated in the arid region and particularly in Wyoming by irrigation, wherever land can be irrigated. There is a necessity for the cultivation of forests in this region, as with the growth of agriculture the demand for timber must grow and the supply must be maintained. I do not think forestry could be successfully developed in the arid region without the aid of irrigation, except in regions properly adapted to it, where the conditions of the soil are different or the rainfall is greater than it is over the average of the western country. The doctrine of riparian rights, if applied, would undoubtedly limit the development of forestry in the arid region. Probably 98 per cent of the possible development. That of course is a rough estimate.

J. A. Van Orsdel, Attorney-General of Wyoming, says (1055):

> Of the lands in Wyoming now arid and uninhabitable and unprofitable I should say that five or six million acres can be reclaimed by the unused waters of the streams in that State. Land, on an average, when it is reclaimed, before it is cultivated or any improvements

placed on it in the way of cultivation or other improvements, is worth about $20 an acre. The lands which can be reclaimed would support an additional population, directly and indirectly, of a million to a million and a half. I estimate that a forty-acre tract of land well irrigated would support a family of five persons. I think it would do that in this country.

F. W. Mondell, member of Congress from Wyoming, says (1179):

According to the best of my information, there are now under irrigation in Wyoming about a million acres. When I went there in 1887, I should say there were about two hundred thousand acres. The average value of these lands is about $25 an acre. From a rather careful estimate made at various times, I am of the opinion that with the unused waters of the streams in Wyoming and by impounding the flood waters we will ultimately irrigate upwards of five million acres—four million in addition to the lands already under irrigation. The greater portion of the land that is now not in irrigation is practically valueless. I think there is very little of it that is worth $1.25 an acre in its raw state. If it should be reclaimed by using the unused waters of the streams and by using the flood waters, in ten years after reclaiming it would be worth on an average $40 an acre; and directly and indirectly two and a half acres of irrigated land in Wyoming will support an inhabitant.

Francis E. Warren, United States Senator from Wyoming, says (1289):

> When I first went to Wyoming there was no development of any consequence along horticultural and agricultural lines. * * * There has been considerable development along agricultural and horticultural lines since that time. Aside from the railroad and some coal mining, there would have been nothing to cause settlement in Wyoming at the present time without irrigation, and the raising of livestock could not be successfully carried on now without irrigation. I can conceive of scarcely any business that could exist without irrigation. Even the development of our mines must have irrigation behind it. * * * The main portion of the highly productive lands that can be irrigated by corporate or Government investment in the way of irrigation works is yet there unutilized. I will say that more than one-tenth of the area of Wyoming can be irrigated. I should think that this would more than quadruple the number of people. When you come to intensive cultivation, five or ten acres is plenty for the support of a family.

Joseph M. Carey, ex-United States Senator from Wyoming, states, among other things (1325), that four or five million acres can be added to the irrigated area in Wyoming; that this will support a population of a million or two million people; that this unreclaimed land has now no positive value; that within twenty-five years, if irrigated, it would be worth

from $50 to $150 an acre; and that the tendency of irrigation (1331) is to divide the land up; that a 40-acre tract with a good water right is sufficient to support an ordinary family of five; that the development which has been made in the arid region of the United States and that which is to be made depends almost entirely on the utilization of the waters of that region for irrigation (1332); that the production from an irrigated acre of land in the arid region is very much larger than in the humid region; that he has seen 70 bushels of wheat harvested from an acre of irrigated land in Wyoming; that in the State of Delaware, where he formerly lived, 20 bushels to the acre was considered a good crop; that in Wyoming are irrigated lands that could raise enormous crops of small grains, and more per acre than back East where they depend upon rainfall (1334).

Miguel A. Otero, Governor of New Mexico (1077), in effect says that two or three million acres of land could yet be reclaimed by irrigation in New Mexico and when reclaimed would be worth from $25 to $100 an acre, and some might go as high as $250 an acre; that most of this land is now public land and worth from 40 cents to $1.25 an acre; that if 3,000,000 acres of land were reclaimed by irrigation the same would support over a million people.

Luther Foster, President of the Agricultural College of New Mexico, says (1080) that from six to eight million acres of arid land can yet be reclaimed in New Mexico and that a 40-acre tract would easily

support a family of six directly. At page 1084 this same witness says that the lands in New Mexico and Colorado that are cultivated by irrigation are much more productive than in nonirrigated countries and will support a larger population for a given area.

T. B. Catron, ex-Delegate to Congress from New Mexico, stated, among other things (1091), that there are about a million and a half acres under irrigation in the Territory of New Mexico and (1092) that fully 15,000,000 acres of irrigated land could be added thereto by using the unused waters and properly impounding and conserving the flood waters.

R. E. Twitchell, who has lived in New Mexico since 1882, and who had been engaged in irrigation to some extent, at page 1098 says, in effect, that 40 acres of irrigated land will support a family, and that the future of the Territory depends upon the continuous application of the waters of the streams to the arid region.

J. W. Poe, President of the Citizens' National Bank of Roswell, N. M., and who has lived in that immediate neighborhood since 1881, states, among other things (1121), that when he first came to the vicinity of Roswell there were about 150 to 200 acres of land under irrigation in that neighborhood, and that there is now from 18,000 to 20,000 acres which has been reclaimed by irrigation; that before the land was irrigated it was worth probably $1.25 per acre, and that it is now worth $40 an acre and upward; that there were no trees to be seen in his locality when he

first went there, and (1122) at the present time there are many thousands of trees in and around Roswell, independently of fruit trees; that this tree growth has been produced by irrigation and could not have been produced without it. On cross-examination by counsel for Colorado, he states that it is possible to support a family of five on 10 acres of irrigated land in the vicinity of Roswell.

William G. Hamilton, who has been connected with irrigation enterprises in Colorado and New Mexico since 1884, says (1125) that in Chaves County, N. M., there is probably 20,000 acres of irrigated land and in Eddy County about 14,000 acres; that these lands are incapable of producing crops without irrigation and in their natural state are not worth over $1.25 an acre, and (1126) that it is now worth from $40 to $50 an acre; that 100,000 acres can yet be irrigated in the counties of Chaves and Eddy, and if irrigated would increase the population 1,000 per cent.

Francis G. Tracy, President of the Pecos Irrigation Company, which operates in Eddy County, N. M., says (1133) that 15,000 acres of land are under irrigation in that county, and that 60,000 acres of arid land can be added to the irrigated area in that county that is now practically valueless (1134), but if irrigated would be worth $50 an acre on the average and would support ten times the present population of Eddy County.

J. J. Hagerman of Roswell, N. M., formerly President of irrigation companies that invested almost

$2,000,000 in irrigation enterprises in Chaves and Eddy counties, N. M., and who had made considerable study of irrigation problems, states, among other things (1149), that from 45,000 to 50,000 acres could be added to the irrigated area in Chaves and Eddy counties, and that this would support an additional population of 100,000 people. At page 1150 he states that he has made a study with regard to the effect of irrigation upon forestry; that it is impossible to develop forestry in the arid region, except in a few small, scattering places, without the aid of irrigation; that when he first came to the Pecos Valley in 1889 he does not remember seeing a tree in the valley, but that since then thousands of trees have grown up.

B. S. Rodey, a Delegate to Congress from New Mexico (1156), states that between 10,000,000 and 15,000,000 acres of land can be irrigated in New Mexico; that one-half of this area is Government land and is of no value except as pasture land and not worth more than 50 cents an acre, and that when irrigated it would be worth from $50 to $300 an acre and would support two or three millions of people.

W. L. Jones, a member of Congress from Washington, stated, among other things (1172), that between 125,000 and 130,000 acres of land have been reclaimed from its arid state by means of irrigation in the eastern part of Washington, and that a great many thousand acres more can be reclaimed; that without irrigation this land, in its present condition, is practically worthless; that if reclaimed by irrigation it would be worth from $35 to $100 an acre and would

sustain a population of a million people, and that the central portion of Washington is practically an arid region.

Theodore A. Bell, member of Congress from California, stated, among other things (1175), that about a million and a half acres of land have been reclaimed from their arid state by irrigation in California and (1176), that between 10,000,000 and 15,000,000 can yet be reclaimed in that State by impounding and using the flood and other waters which could be utilized; that the lands which can be reclaimed would be worth at least $100 an acre and would increase the population tenfold.

Fred T. Dubois, United States Senator from Idaho, among other things stated (1190) that about a million acres of land had been reclaimed by irrigation in Idaho, and that it was worth at least $40 an acre; that four and a half million acres of arid land can yet be reclaimed by irrigation in that State; that the land is now not worth anything, and if reclaimed would be worth $40 an acre on the average; (1191) that the same amount of irrigated lands in Idaho would support a denser population than the same amount of lands in Illinois, where he formerly lived, not irrigated.

Joseph M. Dixon, member of Congress from Montana, stated (1197) that there was about a million acres of irrigated land in Montana, and that about 8,000,000 acres additional could be reclaimed by irrigation; that 8,000,000 acres of additional irrigated land would support a million people directly

and indirectly; (1201) that irrigated lands with an absolute water supply would sell for $35 to $100 an acre, with improvements; that this same land without irrigation would not be worth over $1 or $2 an acre.

J. C. Needham, member of Congress from California, states, among other things (1203), that a large amount of property in California, and in his district particularly, has been created and exists by reason of irrigation; that irrigated land in Fresno County, in said district, is worth $50 an acre when prepared for irrigation and $100 an acre after it is irrigated; that some of this land is worth from $150 to $500 an acre; that the irrigated land in Fresno County could be doubled, and that land without irrigation is worth from $1.25 to $5 an acre.

Henry C. Hansbrough, United States Senator from North Dakota, states (1207) that a large portion of western Dakota, which is in the arid belt, can be made productive by irrigation; that from eight to ten million acres in said State can be reclaimed by irrigation; that this land is not now worth over $1 an acre, but if irrigated would be worth from $30 to $50 an acre, and that less than one-half a section of irrigated land in North Dakota would support a family.

Alexander Oswald Brodie, ex-Governor of Arizona, among other things stated (1259) that when he went to Arizona there was not over 10,000 acres under irrigation; that at the present time there are 350,000 acres irrigated; that before the land was irrigated

$1.25 would be a good price for it, and that the average value of irrigated land is from $30 to $50 an acre.

W. H. Code, Inspector of Irrigation under the Department of the Interior for the Indian reservations throughout the West, stated, among other things (1315), that he had been engaged in irrigation since 1891; that he had charge of forty-seven Indian reservations located in North Dakota, South Dakota, Montana, Washington, California, Idaho, New Mexico, Oregon, Nevada, Wyoming, Colorado, and Utah; that all of these reservations are located in what is known as the arid region; (1316) that there are 48,000,000 acres of unallotted lands within these reservations, and that about three and a quarter million acres are allotted lands; that there are about 116,000 Indians located upon these reservations; that about 200,000 acres are covered by canals; that a million and a half acres can be added to the irrigated area on these reservations; that it is necessary for the support of the Indians residing on said reservations that the lands should be cultivated; that they can only be cultivated by using the waters of the streams, and that the reservations can not be made to support the different tribes of Indians unless irrigation is practiced.

(2) THE POLICY OF THE GOVERNMENT RECOGNIZES AND DEMANDS THAT THE PUBLIC LANDS SHALL BE RECLAIMED, SETTLED, AND CULTIVATED.

"Public policy," says Bouvier, "is a variable quantity. It must and does vary with the habits, capacities, and opportunities of the people."

"The public policy of the Government is to be found in the Constitution and the laws, and the course of administration and decision." (*St. Louis Mining Co.* v. *Montana Mining Co.*, 171 U. S., 650, 655.)

"It is but the manifested will of the State." (*Jacoway* v. *Denton*, 25 Ark., 625, 634.)

"It is manifested by public acts, legislative and judicial." (*Giant Powder Co.* v. *Oregon Pacific Ry. Co. et al.*, 42 Fed. Rep., 470, 474.)

"It can be ascertained only by reference to the Constitution and laws passed under it." Although not created by the judicial department of the Government, it is the province of that department to declare and apply it. (*Lux* v. *Haggin*, 10 Pac. Rep., 674, 702.)

"It is not the interest of the parties alone which is to be considered the true test, but in each particular case, under the facts, the judicial inquiry is, Will the enforcement of the condition be inimical to the public interests?" (*Wakefield* v. *Van Tassel*, 66 N. E., 830, 831.)

A. *The policy of the Government in regard to the reclamation and cultivation of the arid lands as indicated by the Legislative Department.*

Section 9 of the act of July 26, 1866 (14 Stat., 253), now appearing as section 2339, R. S., and section 17 of the act of July 9, 1870 (17 Stat., 218), now appearing as section 2340, read as follows:

> SEC. 2339. Whenever, by priority of possession, rights to the use of water for mining, agriculture, manufacturing, or other purposes have

vested and accrued, and the same are recognized and acknowledged by the local customs, laws, and the decisions of courts, the possessors and owners of such vested rights shall be maintained and protected in the same; and the right of way for the construction of ditches and canals for the purposes herein specified is acknowledged and confirmed; but whenever any person, in the construction of any ditch or canal, injures or damages the possession of any settler on the public domain, the party committing such injury or damage shall be liable to the party injured for such injury or damage.

SEC. 2340. All patents granted, or pre-emption or homesteads allowed, shall be subject to any vested and accrued water rights, or rights to ditches and reservoirs used in connection with such water rights, as may have been acquired under or recognized by the preceding section.

By the first and third sections of the act of March 3, 1877 (19 Stat., 377), commonly called the Desert Land Act, any citizen, or person entitled to become such, might procure title to 640 acres of arid land in the States of California, Oregon, and Nevada, and the Territories of Washington, Idaho, Montana, Utah, Wyoming, Arizona, New Mexico, and Dakota, by conducting water upon and reclaiming the same within three years from the filing of a declaratory statement in the local land office and by the payment to the Government of $1.25 per acre. Section 1 of said act also provided that—

> The water of all lakes, rivers, and other sources of water supply upon the public lands

and not navigable, shall remain and be held free for the appropriation and use of the public for irrigation, mining, and manufacturing purposes, subject to existing rights.

The above act was amended by the act of March 3, 1891 (26 Stat., 1096), and, as amended, was, by section 2 thereof, extended to the State of Colorado. Section 18 of said act of March 3, 1891, reads (p. 1101):

SEC. 18. That the right of way through the public lands and reservations of the United States is hereby granted to any canal or ditch company formed for the purpose of irrigation and duly organized under the laws of any State or Territory which shall have filed, or may hereafter file, with the Secretary of the Interior a copy of its articles of incorporation and due proofs of its organization under the same, to the extent of the ground occupied by the water of the reservoir and of the canal and its laterals, and fifty feet on each side of the marginal limits thereof; also the right to take from the public lands adjacent to the line of the canal or ditch material, earth, and stone necessary for the construction of such canal or ditch: *Provided*, That no such right of way shall be so located as to interfere with the proper occupation by the Government of any such reservation, and all maps of location shall be subject to the approval of the department of the Government having jurisdiction of such reservation, and the privilege herein granted shall not be construed to interfere with the control of water for irrigation and other purposes under authority of the respective States or Territories.

The joint resolution of March 20, 1888 (25 Stat., 618–619), reads:

> Whereas a large portion of the unoccupied public lands of the United States is located within what is known as the arid region and now utilized only for grazing purposes, but much of which, by means of irrigation, may be rendered as fertile and productive as any land in the world, capable of supporting a large population, thereby adding to the national wealth and prosperity;
>
> Whereas all the water flowing during the summer months in many of the streams of the Rocky Mountains, upon which chiefly the husbandman of the plains and the mountain valleys chiefly depends for moisture for his crops, has been appropriated and is used for the irrigation of lands contiguous thereto, whereby a comparatively small area has been reclaimed; and
>
> Whereas there are many natural depressions near the sources and along the courses of these streams which may be converted into reservoirs for the storage of the surplus water which during the winter and spring seasons flows through the streams; from which reservoirs the water there stored can be drawn and conducted through properly constructed canals, at the proper season, thus bringing large areas of land into cultivation and making desirable much of the public land for which there is now no demand: Therefore, be it
>
> *Resolved by the Senate and House of Representatives of the United States of America in*

Congress assembled, That the Secretary of the Interior by means of the Director of the Geological Survey be, and he is hereby, directed to make an examination of that portion of the arid regions of the United States where agriculture is carried on by means of irrigation, as to the natural advantages for the storage of water for irrigating purposes with the practicability of constructing reservoirs, together with the capacity of the streams and the cost of construction and capacity of reservoirs and such other facts as bear on the question of storage of water for irrigating purposes; and that he be further directed to report to Congress as soon as practicable the result of such investigation.

The sundry civil appropriation act for the fiscal year ending October 2, 1888, contains the following provision (25 Stat., 526):

> For the purpose of investigating the extent to which the arid region of the United States can be redeemed by irrigation and the segregation of the irrigable lands in such arid region, and for the selection of sites for reservoirs and other hydraulic works necessary for the storage and utilization of water for irrigation and the prevention of floods and overflows, and to make the necessary maps, including the pay of employees in the field and in office, the cost of all instruments, apparatus, and materials, and all other necessary expenses connected therewith, the work to be performed by the Geological Survey, under the direction of the Secretary of the Interior, the sum of one hundred thousand

dollars, or so much thereof as may be necessary. And the Director of the Geological Survey, under the supervision of the Secretary of the Interior, shall make a report to Congress on the first Monday in December of each year, showing in detail how the said money has been expended, the amount used for actual survey and engineer work in the field in locating sites for reservoirs and an itemized account of the expenditures under this appropriation. And all the lands which may hereafter be designated or selected by such United States surveys for sites for reservoirs, ditches, or canals for irrigation purposes, and all the lands made susceptible of irrigation by such reservoirs, ditches, or canals are from this time henceforth hereby reserved from sale as the property of the United States, and shall not be subject after the passage of this act to entry, settlement, or occupation until further provided by law.

Section 1 of the act of March 2, 1889 (25 Stat., 960), being the general appropriation act for the fiscal year ending June 30, 1890, contains the following provision:

IRRIGATION SURVEY.—For the purpose of investigating the extent to which the arid region of the United States can be redeemed by irrigation and the segregation of the irrigable lands in such arid region, and for the selection of sites for reservoirs and other hydraulic works necessary for the storage and utilization of water for irrigation and for ascertaining the cost thereof and the prevention of floods and overflows, and to make the necessary maps, including

the pay of the employees in the field and in office, the cost of all instruments, apparatus, and materials, and all other necessary expenses connected therewith, the work to be performed by the Geological Survey, under the direction of the Secretary of the Interior, two hundred and fifty thousand dollars, of which sum fifty thousand dollars shall be immediately available; and the Director of the Geological Survey, under the supervision of the Secretary of the Interior, shall make a report to Congress on the first Monday in December of each year, showing in detail how the said money has been expended, the amount used for actual survey and engineer work in the field in locating sites for reservoirs, and an itemized account of the expenditures under this and any future appropriation.

To aid the States in the reclamation, settlement, and cultivation of the arid land Congress, by section 4 of the civil appropriation act of the fiscal year ending June 30, 1895, dated August 4, 1894 (28 Stat., 422), commonly called the Carey Act, granted to each State not exceeding 1,000,000 acres of public lands upon condition that the State should cause to be irrigated, reclaimed, occupied, and cultivated by actual settlers 20 acres of each 160-acre tract within ten years after the passage of the act.

For a number of years Congress has annually appropriated large sums of money to be used under the direction of the Secretary of Agriculture in making investigations and reports with respect to the agricultural development of the arid lands.

By act of September 30, 1890 (26 Stat., 504, 526), $40,000 was appropriated for this purpose.

By act of July 5, 1892 (27 Stat., 74, 76), $6,000 was appropriated to enable the Secretary of Agriculture "to collect information as to the best modes of agriculture by irrigation."

The same amount for the same purpose was appropriated by act of March 3, 1893 (27 Stat., 734, 741), and also by act of August 8, 1894 (28 Stat., 264, 271).

By act of March 2, 1895, $15,000 was also appropriated for the same purpose (28 Stat., 727, 735); and by act of March 22, 1898, (30 Stat., 330, 335), $10,000 was so appropriated.

By act of March 1, 1899 (30 Stat., 947, 953), it was provided, among other things, as follows:

> IRRIGATION INVESTIGATIONS.—To enable the Secretary of Agriculture to investigate and report upon the laws and institutions relating to irrigation and upon the use of irrigation waters, with special suggestions of better methods for the utilization of irrigation waters in agriculture than those in common use, and for the preparation, printing, and illustration of of reports and bulletins on irrigation; and the agricultural experiment stations are hereby authorized and directed to cooperate with the Secretary of Agriculture in carrying out said investigations in such manner and to such extent as may be warranted by a due regard to the varying conditions and needs of the respective States and Territories, and as may be mutually agreed upon; and ten thousand dol-

> lars of the amount hereby appropriated shall be immediately available, thirty-five thousand dollars.

By act of May 25, 1900, $50,000 was appropriated for the same purpose as that of the act last aforesaid (31 Stat., 191, 199, 200); and the same amount was appropriated for the same purpose by act of March 2, 1901 (31 Stat., 922, 936).

By act of June 3, 1902, $65,000 was appropriated for practically the same purpose (32 Stat., 286, 302); and the same sum for the same purpose was appropriated by act of March 3, 1903 (Ib., 1147, 1165).

By act of April 23, 1904, $67,000 was appropriated for the same purpose (33 Stat., 276, 294); and $74,000 by act of March 3, 1905 (Ib., 861, 882).

Since 1894 Congress has made appropriations looking to the irrigation of the arid lands of the Indian reservations. By act of August 15, 1894 (28 Stat., 286, 305), $30,000 was appropriated for the construction, purchase, and use of irrigating machinery on Indian reservations, to be expended in the discretion of the Secretary of the Interior and subject to his control. The same amount for the same purpose was appropriated by act of March 2, 1895 (28 Stat., 876, 900). In this connection see also acts of June 10, 1896 (29 Stat., 321, 341), and of June 7, 1897, (30 Stat., 85).

By act of March 3, 1901 (31 Stat., 1058, 1075), it is provided, among other things, as follows:

> For construction of ditches and reservoirs, purchase and use of irrigating tools and appliances, and purchase of water rights on Indian

reservations, in the discretion of the Secretary of the Interior and subject to his control, one hundred thousand dollars: *Provided*, That the Secretary of the Interior may employ such number of superintendents of irrigation, who shall be skilled irrigation engineers, not to exceed two, as in his judgment may be necessary to secure the construction of ditches and other irrigation works in a substantial and workmanlike manner; and also one clerk in the Office of Indian Affairs, at a salary of one thousand dollars per annum.

By act of May 27, 1902, $50,000 was appropriated for the same purpose (32 Stat., 245, 261); also by act of March 3, 1903 (Ib., 982, 996).

By act of April 21, 1904 (33 Stat., 189, 206), $185,000 was appropriated for the same purpose and the same sum was appropriated for the same purpose by act of March 3, 1905 (Ib., 1048, 1060).

On June 17, 1902 (32 Stat., 388), Congress passed the so-called reclamation act. By section 1 thereof certain moneys arising from the disposal of public lands in Arizona, California, Colorado, Idaho, Kansas, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oklahoma, Oregon, South Dakota, Utah, Washington, and Wyoming, from June 30, 1901, are "to be used in the examination and survey for and the construction and maintenance of irrigation works for the storage, diversion, and development of waters for the reclamation of arid and semiarid lands in the said States and Territories and for the payment of all other expenditures provided for in this act." The act fur-

ther provides that the moneys so arising shall be expended and the irrigation works erected under the direction and supervision of the Secretary of the Interior. Section 6 provides that "the title to and the management and operation of the reservoirs and the works necessary for their protection and operation shall remain in the Government until otherwise provided by Congress."

Sections 7 and 8 read as follows:

> SEC. 7. That where, in carrying out the provisions of this act, it becomes necessary to acquire any rights or property, the Secretary of the Interior is hereby authorized to acquire the same for the United States by purchase or by condemnation under judicial process and to pay from the reclamation fund the sums which may be needed for that purpose, and it shall be the duty of the Attorney-General of the United States, upon every application of the Secretary of the Interior under this act, to cause proceedings to be commenced for condemnation within thirty days from the receipt of the application at the Department of Justice.
>
> SEC. 8. That nothing in this act shall be construed as affecting or intended to affect or to in any way interfere with the laws of any State or Territory relating to the control, appropriation, use, or distribution of the water used in irrigation, or any vested right acquired thereunder, and the Secretary of the Interior, in carrying out the provisions of this act, shall proceed in conformity with such laws, and nothing herein shall in any way affect

any right of any State or of the Federal Government or of any landowner, appropriator, or user of water in, to, or from any interstate stream or the waters thereof: *Provided*, That the right to the use of water acquired under the provisions of this act shall be appurtenant to the land irrigated, and beneficial use shall be the basis, the measure, and the limit of the right.

See also acts of April 27, 1904 (33 Stat., 352, 359); and June 12, 1906 (34 Stat., 259).

B. *The policy of the Government in regard to the reclamation and cultivation of the arid lands as indicated by the Executive Department.*

President Roosevelt, in his annual message to the Fifty-seventh Congress, first session, among other things, says (Cong. Rec., vol. 35, pp. 85, 86):

> The western half of the United States would sustain a population greater than that of our whole country to-day if the waters that now run to waste were saved and used for irrigation. The forest and water problems are perhaps the most vital internal questions of the United States.
>
> * * * * *
>
> The object of the Government is to dispose of the land to settlers who will build homes upon it. To accomplish this object, water must be brought within their reach.
>
> The pioneer settlers on the arid public domain chose their homes along streams, from which they could themselves divert the

water to reclaim their holdings. Such opportunities are practically gone. There remain, however, vast areas of public land which can be made available for homestead settlement, but only by reservoirs and main-line canals impracticable for private enterprise. These irrigation works should be built by the National Government. The lands reclaimed by them should be reserved by the Government for actual settlers, and the cost of construction should, so far as possible, be repaid by the land reclaimed. The distribution of the water, the division of the streams among irrigators, should be left to the settlers themselves in conformity with State laws and without interference with those laws or with vested rights. The policy of the National Government should be to aid irrigation in the several States and Territories in such manner as will enable the people in the local communities to help themselves and as will stimulate needed reforms in the State laws and regulations governing irrigation.

The reclamation and settlement of the arid lands will enrich every portion of our country, just as the settlement of the Ohio and Mississippi valleys brought prosperity to the Atlantic States. The increased demand for manufactured articles will stimulate industrial production, while wider home markets and the trade of Asia will consume the larger food supplies and effectually prevent western competition with eastern agriculture. Indeed, the products of irrigation will be consumed chiefly in upbuilding local centers of mining

and other industries, which would otherwise not come into existence at all. Our people as a whole will profit, for successful home-making is but another name for the upbuilding of the nation.

* * * * *

Whatever the nation does for the extension of irrigation should harmonize with and tend to improve the condition of those now living on irrigated land. We are not at the starting point of this development. Over two hundred millions of private capital has already been expended in the construction of irrigation works and many million acres of arid land reclaimed. * * * The security and value of the homes created depend largely on the stability of titles to water; but the majority of these rest on the uncertain foundation of court decisions rendered in ordinary suits at law.

* * * * *

In the arid States the only right to water which should be recognized is that of use. In irrigation this right should attach to the land reclaimed and be inseparable therefrom. * * *

The benefits which have followed the unaided development of the past justify the nation's aid and cooperation in the more difficult and important work to be accomplished. Laws so vitally affecting homes as those which control the water supply will only be effective when they have the sanction of the irrigators; reforms can only be final and satisfactory when they come through the enlightenment of the

people most concerned. The larger development which national aid insures should, however, awaken in every arid State the determination to make its irrigation system equal in justice and effectiveness that of any country in the civilized world. Nothing could be more unwise than for isolated communities to continue to learn everything experimentally, instead of profiting by what is known elsewhere. We are dealing with a new and momentous question, in the pregnant years while institutions are forming, and what we do will affect not only the present but future generations.

Our aim should be not simply to reclaim the largest area of land and provide homes for the largest number of people, but to create for this new industry the best possible social and industrial conditions; and this requires that we not only understand the existing situation, but avail ourselves of the best experience of the time in the solution of its problems. A careful study should be made, both by the nation and the States, of the irrigation laws and conditions here and abroad. Ultimately it will probably be necessary for the nation to cooperate with the several arid States in proportion as these States by their legislation and administration show themselves fit to receive it.

In his message to the same Congress, second session, in volume 36 of the Congressional Record, at page 11, President Roosevelt says:

Few subjects of more importance have been taken up by the Congress in recent years than

the inauguration of the system of nationally-aided irrigation for the arid regions of the far West. A good beginning therein has been made. Now that this policy of national irrigation has been adopted the need of thorough and scientific forest protection will grow more rapidly than ever throughout the public-land States.

In his annual message to the 58th Congress, second session, dated December 7, 1903, found in volume 38 of the Congressional Record, page 7, President Roosevelt further states:

> The work of reclamation of the arid lands of the West is progressing steadily and satisfactorily under the terms of the law setting aside the proceeds from the disposal of public lands. The corps of engineers known as the Reclamation Service, which is conducting the surveys and examinations, has been thoroughly organized, especial pains being taken to secure, under the civil-service rules, a body of skilled, experienced, and efficient men. Surveys and examinations are progressing throughout the arid States and Territories, plans for reclaiming works being prepared and passed upon by boards of engineers before approval by the Secretary of the Interior. In Arizona and Nevada, in localities where such work is preeminently needed, construction has already been begun. In other parts of the arid West various projects are well advanced towards the drawing up of contracts, these being delayed in part by necessities of reaching agreements or understanding as regards rights of way or acquisition of real estate. Most of

the works contemplated for construction are of national importance, involving interstate questions or the securing of stable, self-supporting communities in the midst of vast tracts of vacant land. The nation as a whole is of course the gainer by the creation of these homes, adding as they do to the wealth and stability of the country, and furnishing a home market for the products of the East and South. The reclamation law, while perhaps not ideal, appears at present to answer the larger needs for which it is designed. Further legislation is not recomended until the necessities of change are more apparent.

The study of the opportunities of reclamation of the vast extent of arid land shows that whether this reclamation is done by individuals, corporations, or the State, the sources of water supply must be effectively protected and the reservoirs guarded by the preservation of the forests at the headwaters of the streams. The engineers making the preliminary examinations continually emphasize this need and urge that the remaining public lands at the headwaters of the important streams of the West be reserved to insure permanency of water supply for irrigation. Much progress in forestry has been made during the past year. The necessity for perpetuating our forest resources, whether in public or private hands, is recognized now as never before. The demand for forest reserves has become insistent in the West, because the West must use the water, wood, and summer range which only such reserves can supply.

Again, in his annual message of December 6, 1904, to the 58th Congress, 3d session, found in volume 39 of the Congressional Record, page 14, President Roosevelt stated:

> During the two and a half years that have elapsed since the passage of the reclamation act rapid progress has been made in the surveys and examinations of the opportunities for reclamation in the thirteen States and three Territories of the arid West. Construction has already been begun on the largest and most important of the irrigation works, and plans are being completed for works which will utilize the funds now available. * * * The reclamation act has been found to be remarkably complete and effective, and so broad in its provisions that a wide range of undertakings has been possible under it. At the same time, economy is guaranteed by the fact that the funds must ultimately be returned to be used over again.
>
> It is the cardinal principle of the forest-reserve policy of this Administration that the reserves are for use. Whatever interferes with the use of their resources is to be avoided by every possible means. But these resources must be used in such a way as to make them permanent.
>
> The forest policy of the Government is just now a subject of vivid public interest throughout the West and to the people of the United States in general. The forest reserves themselves are of extreme value to the present as well as to the future welfare of all the Western

> public-land States. They powerfully affect the use and disposal of the public lands. They are of special importance because they preserve the water supply and the supply of timber for domestic purposes, and so promote settlement under the reclamation act. Indeed, they are essential to the welfare of every one of the great interests of the West.

Also in his annual message to the 59th Congress, 1st session, dated December 5, 1905, found in volume 40 of the Congressional Record at page 100, President Roosevelt says:

> The creation of small irrigated farms under the reclamation act is a powerful offset to the tendency of certain other laws to foster or permit monopoly of the land. Under that act the construction of great irrigation works has been proceeding rapidly and successfully, the lands reclaimed are eagerly taken up, and the prospect that the policy of national irrigation will accomplish all that was expected of it is bright. The act should be extended to include the State of Texas.

C. *The policy of the Government in respect to the reclamation and cultivation of the arid lands as indicated by the Judicial Department.*

In *Atchison* v. *Peterson* (20 Wall., 507, 513) this court, through Mr. Justice Field, in speaking of the ninth section of the act of July 26, 1866 (now sec. 2339, R. S.), said, in effect, that said section was a recognition by Congress of the doctrine of the prior

appropriation of the waters of natural streams for beneficial purposes.

In *Basey et al.* v. *Gallagher* (20 Wall., 670, 681–682) the same justice says:

> The question on the merits in this case is whether a right to running waters on the public lands of the United States for purposes of irrigation can be acquired by prior appropriation, as against parties not having the title of the Government. Neither party has any title from the United States; no question as to the rights of riparian proprietors can therefore arise. It will be time enough to consider those rights when either of the parties has obtained the patent of the Government. At present both parties stand upon the same footing; neither can allege that the other is a trespasser against the Government without at the same time invalidating his own claim.
>
> In the late case of *Atchison* v. *Peterson*, we had occasion to consider the respective rights of miners to running waters on the mineral lands of the public domain; and we there held that by the custom which had obtained among miners in the Pacific States and Territories, the party who first subjected the water to use, or took the necessary steps for that purpose, was regarded, except as against the Government, as the source of title in all controversies respecting it; that the doctrines of the common law declaratory of the rights of riparian proprietors were inapplicable, or applicable only to a limited extent, to the necessities of miners, and were inadequate to their protection; that the

> equality of right recognized by that law among all the proprietors upon the same stream, would have been incompatible with any extended diversion of the water by one proprietor, and its conveyance for mining purposes to points from which it could not be restored to the stream; that the Government by its silent acquiescence had assented to and encouraged the occupation of the public lands for mining; and that he who first connected his labor with property thus situated and open to general exploration did in natural justice acquire a better right to its use and enjoyment than others who had not given such labor; that the miners on the public lands throughout the Pacific States and Territories, by their customs, usages, and regulations, had recognized the inherent justice of this principle and the principle itself was at an early period recognized by legislation and enforced by the courts in those States and Territories and was firmly approved by the legislation of Congress in 1866. The views there expressed and the rulings made are equally applicable to the use of water on the public lands for purposes of irrigation.

Again, on page 683, in referring to the case of *Tartar* v. *Spring Creek Water and Mining Company*, decided in 1885 by the Supreme Court of California (5 Cal., 397), Mr. Justice Field says:

> Ever since that decision it has been held generally throughout the Pacific States and Territories that the right to the water by appropriation for any beneficial purpose is entitled to protection.

Again he says (683, 684), in commenting upon the aforesaid ninth section of the act of 1866:

> It is very evident that Congress intended, although the language used is not happy, to recognize as valid the customary law with respect to the use of water which had grown up among the occupants of the public land under the peculiar necessities of their condition; and that law may be shown by evidence of the local customs, or by the legislation of the State or Territory or the decisions of the courts.

In *Jennison* v. *Kirk* (98 U. S., 453) the same justice, speaking for the entire court, says, on page 460, with respect to the ninth section of the act of 1866, that it meant—

> that whenever rights to the use of water by priority of possession had become vested, and were recognized by the local customs, laws and decisions of the courts, the owners and possessors should be protected in them; and that the right of way for ditches and canals incident to such water rights, being recognized in the same manner, should be "acknowledged and confirmed."

In *Broder* v. *Water Company* (101 U. S., 274) Mr. Justice Miller says, among other things, at page 276:

> It is the established doctrine of this court that rights of miners, who had taken possession of mines and worked and developed them, and the rights of persons who had constructed canals and ditches to be used in mining operations and for purposes of agri-

> cultural irrigation, in the region where such artificial use of the water was an absolute necessity, are rights which the Government had, by its conduct, recognized and encouraged, and was bound to protect, before the passage of the act of 1866. We are of opinion that the section of the act which we have quoted was rather a voluntary *recognition of a preexisting right of possession*, constituting a valid claim to its continued use, than the establishment of a new one.

In *Fallbrook Irrigation District* v. *Bradley* (164 U. S., 112) Mr. Justice Peckham, delivering the opinion of the court, at page 161 states that to irrigate and bring under cultivation large areas of arid lands "would seem to be a public purpose and a matter of public interest, not confined to the landowners, or even to any one section of the State."

In *United States* v. *Rio Grande Dam and Irrigation Company* (174 U. S., 690) Mr. Justice Brewer, in speaking of the aforesaid act of Congress of July 26, 1866, of the act of March 3, 1877, commonly known as the Desert Act, and the 18th section of the act of March 3, 1891 (26 Stat., 1101), says, at page 706:

> In reference to all these cases of purely local interest the obvious purpose of Congress was to give its assent, so far as the public lands were concerned, to any system, although in contravention to the common-law rule, which permitted the appropriation of those waters for legitimate industries.

But it was further held that Congress did not mean by these acts "to confer upon any State the right to

appropriate all the waters of the tributary streams which unite in a navigable water course, and so destroy the navigability of that water course, in derogation of the interests of all the people of the United States."

In *Guiterres* v. *Albuquerque Land and Irrigation Company* (188 U. S., 545) this court upheld the right of a Territorial legislature to enact a statute providing for the organization of corporations for the purpose of constructing and maintaining reservoirs and canals or ditches and pipe lines for the purpose of irrigating riparian and nonriparian lands, etc.

In *Clark* v. *Nash* (198 U. S., 361) this court held that a statute of Utah which provided for condemnation proceedings by an individual for the purpose of obtaining water to irrigate his land was not inhibited by any provision in the Federal Constitution. This decision was based upon the ground that irrigation was a public use.

There are decisions of the United States Circuit Courts of Appeals for the Eighth and Ninth Circuits, also of the Circuit and District Courts in said circuits, which declare that the policy of the Government requires and demands the utilization of the arid lands by irrigation; but as the policy in this regard is clearly manifested by decisions of this court, it is not deemed necessary to quote any of the decisions of the lower Federal courts.

V.

THE PUBLIC ARID LANDS CAN NOT BE RECLAIMED, NOR CAN THE POLICY OF THE GOVERNMENT BE CARRIED OUT, UNDER THE APPLICATION OF THE COMMON-LAW DOCTRINE OF RIPARIAN RIGHTS, NOR UNDER THE APPLICATION OF THAT DOCTRINE AS THE SAME HAS BEEN MODIFIED BY THE LEGISLATIVE AND DECLARED BY THE JUDICIAL DEPARTMENTS OF SOME OF THE WESTERN STATES.

As the common-law doctrine of riparian rights is generally understood, a riparian owner is "entitled to have the stream come to him in its natural state, in flow, quantity and quality, and it must go from his land in like manner, unobstructed in its passage." (Col. Law Rev., vol. 1, No. 8, p. 505.) He has a natural and equal right to the use of the water in the stream adjacent to his land without diminution or alteration. He only "can employ or suffer the employment of the waters for any purpose." (*Lux* v. *Haggin*, 10 Pac., 674, 755.)

While counsel for the intervenor introduced a number of witnesses to support the proposition of the above heading, complainant's counsel failed, by any evidence, to challenge its correctness. In their brief, however (p. 209), they claim that of the States in which the Government owns arid land, "California, Oregon, Washington, North and South Dakota, Nebraska, and Texas," have, like Kansas, "adopted a rule" in regard to the use of the waters for irrigation which is a modification of "the most extreme form of the rule of riparian rights," and that this rule "will allow the largest development * * *

consistent with the rights of all" the citizens. (Kans. br. 209.)

The rule referred to by counsel is known as the California doctrine, having originated with the Supreme Court of the State of California, and as set forth in the case of *Lux* v. *Haggin* (supra, 755), is as follows:

> Riparian proprietors are entitled to a reasonable use of the waters of the stream for the purpose of irrigation. What is such reasonable use is a question of fact, and depends upon the circumstances appearing in each particular case.

The California doctrine, as now understood, says the Supreme Court of Wyoming, in *Willey* v. *Decker* (73 Pac., 210, 214), briefly stated, is:

> that while a stream is situated on the public lands of the United States a person may, under the customs and laws of a State and the legislation of Congress, acquire by prior appropriation, the right to use the waters thereof for mining, agricultural, and other beneficial purposes, and to construct and maintain ditches and reservoirs over and upon the public land, such right being good against all other private persons, and by statute good as against the United States and its subsequent grantees; but that, when a grantee of the United States obtains title to a tract of the public land bordering on a stream, the waters of which have not been hitherto appropriated, his patent is not subject to any possible appropriation subsequently made by another party without

> his consent. In other words, it is held under that doctrine that the rules of prior appropriation, founded upon local customs and laws, and ratified by Congressional legislation, are confined in their operation to the public domain of the United States.

What are riparian lands which can be so irrigated does not seem to have been definitely decided by the Supreme Court of the State of California, nor by any court which has approved the California doctrine (1379). The Supreme Court of Nebraska, in *Crawford County* v. *Hathaway et al.* (93 N. W. Rep., 781, 791), suggested that the term "riparian lands" does not extend beyond the Government 40-acre subdivision bordering on the stream. Counsel for complainant claim (Kans. br., 211) that "riparian lands are such as are directly affected by the presence of the stream," and do "not depend upon geographical lines nor political subdivisions of land." In his oral argument upon the demurrer, Mr. Ware, counsel for Kansas, stated (Oral Arguments, etc., 116):

> We conceive nonriparian land to be such land as that the drainage and the seepage will not go back to the original stream.

In *Clark* v. *Allaman* (80 Pac. Rep., 571) the Supreme Court of Kansas in substance held that nonriparian lands were those beyond the watershed of the stream.

In the absence of any definite rule in regard to what should be considered "riparian lands," as the term is employed in the opinion of the court in

Lux v. *Haggin*, *supra*, counsel for the intervenor, in the examination of witnesses, assumed that they do not extend farther than one-quarter of a mile to a mile from the stream.

Before referring to the evidence offered by intervenor to support the present proposition (V), we desire to call the court's attention to an extract from a publication entitled "Works on Irrigation," in respect to the case of *Lux* v. *Haggin*. Judge Works is an eminent lawyer, residing at Los Angeles, Cal., and is regarded in that State as an authority on the law of irrigation. He says (pp. 11, 12):

> The question of the extent of the rights of riparian owners in and to the waters of a stream flowing past their lands, for purposes of irrigation, has been before the courts of this State many times, and with varying results. The leading case on the subject is *Lux* v. *Haggin*, 69 Cal., 255. There the effort was made to define and measure the rights of a riparian owner in this State by the common-law doctrine on the subject. The contest was a prolonged and bitter one. The court was divided on the question whether the common law must be applied in this State or whether it should be modified by the existing natural conditions prevailing, on the ground that the common-law doctrine, if maintained, would result in ruinous consequences, and whether the common-law doctrine was modified by our code provisions providing for the appropriation of water. The opinions delivered in this case are of great

interest and exhibit great learning, industry, and research on the part of the justices delivering them. The majority opinion sustained the contention that the common law must prevail and that the court must not be swerved from its enforcement by the plea of differing conditions and injurious consequences. But the court, while not overruling this case, has, in numerous subsequent cases, departed from it, and the court, in that and later cases, has done precisely what it was then held could not be done—allowed the necessity for some different rule of right, as between the riparian owners themselves and between them and the appropriator, to prevail over the law as it was then declared to be.

But, strangely enough, while the main question in that case was whether the common-law right of a riparian owner should be recognized as existing at all in this State or not, and the right was upheld, manifestly only because the majority of the court felt constrained to that conclusion by strict rules of law, that and later cases, or some of them, have extended the right of a riparian owner far beyond that vested in him at common law, and has thus in a measure, if not entirely, subverted and destroyed the common-law riparian right.

It will be noticed also that the case of *Lux* v. *Haggin* was decided in 1886. At that time a large portion of the public domain capable of producing crops without irrigation and by natural rainfall was undisposed of, and the necessity of reclaiming and cultivating arid and was not appreciated. (1205.) That decision was

by a divided court, and did not meet with the approval of the citizens of the State. (1378–1379.) This is seen in the passage by the legislature of that State, in 1887, of what is commonly known as the "Wright act." This act is based upon "the doctrine of prior appropriation and the application of waters to a beneficial use." (1402.) The Supreme Court of the State of California held said act to be valid. (See authorities cited in Works on Irrigation, p. 120.) It was held to be in violation of the Constitution of the United States (68 Fed., 948) by Judge Ross, who, as a Supreme Court judge of the State of California, wrote a strong dissenting opinion in the case of *Lux* v. *Haggin* when it was first decided (4 Pac. Rep., 929–937). This court upheld the constitutionality and validity of the act in *Fallbrook Irrigation District* v. *Bradley*, 164 U. S., 112, thus reversing the decision of Judge Ross. This act, in effect, has been adopted by three of the States which had approved of the California doctrine, viz, Kansas, Nebraska, and Washington. (See Wiel's Water Rights in the Western States, pp. 45–46.)

F. H. Newell, Chief Engineer of the Reclamation Service, on direct examination, says (1267):

> It is highly improbable that under any such doctrine any development along agricultural or horticultural lines could have been or could be made in the arid region, and probably not over, say, 10 per cent of the present area could have been irrigated under riparian rights from the streams. Such a doctrine would

> practically arrest all future development, as the lands now easily irrigated along the streams are pretty well developed. Should it be established that the irrigated area in the arid region should be confined to lands adjoining the stream or within three-quarters of a mile thereof, it would arrest further development, as most lands bordering on the streams are now fairly well irrigated. * * * If the doctrine of riparian rights should be enforced in the arid region, or the doctrine that the irrigated area should be confined to lands within three-quarters of a mile from the stream, such doctrines would practically nullify the [reclamation] act.

Elwood Mead, Chief of the Irrigation and Drainage Investigations of the Department of Agriculture (1377) says:

> Under what was formerly considered the doctrine of riparian rights, which did not permit of the diminution in quantity or the impairment in quality of the water, it would be impossible to make any use of the streams in irrigation, and when the doctrine is modified, as it has been in numberless instances, because of the necessity of an increased use of the water supply, then it ceases to become a definite doctrine, and the extent to which use is possible is so uncertain that it always becomes a very serious obstacle to development.

Again, on page 1379, Mr. Mead says:

> In respect to the modified doctrine of riparian rights of which I have spoken, I do not

> understand it. Each new decision, take it in California, is a new interpretation. I have read the decisions in Nebraska with respect to irrigation, and the doctrine the courts there undertook to lay down as governing the western part of the State. I am not able to understand how the doctrine laid down by the Supreme Court of Nebraska can be applied and permit the continuance of the development that already exists.

Louis G. Carpenter, State Engineer of Colorado, says (772):

> I do not see how there can be any development in the arid region by irrigation if the common-law doctrine of riparian rights or any modified common law doctrine of riparian rights exists.

George H. Maxwell, Chairman of the Executive Committee of the National Irrigation Association (1165), says:

> But the application of the principle that the lower riparian owner is entitled to have the water come down to him undiminished in quantity and undeteriorated in quality, applied in its strictness to the West, would absolutely prevent its development. That is, prevent any future development; and with respect to present development, if you should apply it to-day to existing conditions, eliminating all questions of estoppel and eliminating rights which have grown up to irrigate, which the courts have conceded by reason of riparian ownership as a reasonable use of the water for

irrigation—if you should apply the law without these limitations you would destroy all communities in many places.

Should it be established that the irrigated area in the arid region should be confined to lands riparian to the stream, say the first and second 40s, its effect would be destructive upon any future development in the arid region, and would cause an immense destruction of present development.

If a doctrine should be applied that would confine the irrigated area to riparian lands, it would practically render inoperative the reclamation act. Of course I want to make it clear that I do not concede that that is the law of the arid region.

To the same effect see also the testimony of W. L. Jones, member of Congress from Washington (1172–3); Theodore A. Bell, member of Congress from California (1175, 1176–7); Frank W. Mondell, member of Congress from Wyoming (1179–1181); Fred T. Dubois, United States Senator from Idaho (1190–1191–2); Joseph N. Dixon, member of Congress from Montana (1196, 1197–8); J. C. Needham, member of Congress from California (1203–6); Henry C. Hansbrough, United States Senator from North Dakota (1206–8); Alexander Oswald Brodie, former governor of Arizona (1259–1260); Joseph L. B. Alexander of Arizona (1264); Francis E. Warren, United States Senator from Wyoming (1289–1291); W. H. Code, Irrigation Inspector for Indian Reservations under the Department of the Interior (1315–1317); and Joseph M.

Carey, formerly United States Senator from Wyoming (1324–8).

Clarence T. Johnston, State Engineer of Wyoming, on direct examination, at page 1023 says:

> I am familiar with the doctrine or riparian rights. I think it would have been impossible to reclaim the lands in Wyoming which have already been reclaimed if that doctrine were to prevail or had prevailed, and the effect of such a doctrine upon the future development of Wyoming would be to prevent such development largely.
>
> * * * * *
>
> I am familiar with the doctrine which is by some considered a modification of the riparian-rights doctrine, which prevails in California, Oregon, and Washington, and which has recently been invoked in Nebraska. I do not think such a doctrine is applicable to the conditions prevailing in the arid region, and where the modification is made it seems to me it is in a way recognizing the doctrine of appropriation as soon as the water is used.
>
> I am familiar with the objects and purposes of what is known as the reclamation act passed by the United States Congress on June 17, 1902. The application of the doctrine of riparian rights would prevent irrigation development under that act almost entirely. The application of the doctrine which prevails in California and Nebraska would affect development largely in the same way, probably depending on how much the doctrine is modified.
>
> I am familiar with the act of Congress known

as the Carey Act, passed August 18, 1894, and to be found in 27 U. S. Stats., 372, 422, sec. 4. Wyoming has accepted the provisions of that act, and approximately, under it 60,000 acres have been reclaimed up to the present time. Five hundred thousand acres are in process of reclamation. The doctrine of riparian rights if applied in Wyoming would almost absolutely impair the value of this act.

Nellis E. Corthell, a practicing attorney at Laramie, Wyo., of twenty-one years' standing, on direct examination, at page 1035 says:

My understanding of the doctrine of riparian rights is to give all of the riparian owners on the stream the right to a reasonable use of the water for irrigation as well as other purposes; that is to say, distributing the water among all irrigators on the entire length of the stream. There is a vast body of grazing land in Wyoming irrigated from the streams that is non-riparian. This land could not have been reclaimed under the doctrine of riparian rights if anyone should have complained.

I understand what is meant by the doctrine prevailing in California as laid down in the case of *Lux* v. *Haggin* and in the case from Nebraska known as the *Crawford Company* v. *Hathaway*. As I understand the doctrine in those cases, its application to the arid region would very seriously affect the future development therein by irrigation, because it would prevent people from investing money in such precarious property. It is hardly conceivable that under that doctrine the Government or any one else would

invest vast sums of money in the storage of water that they might be compelled to turn down the streams on the complaint of any lower appropriator.

On cross-examination this witness says (1040):

When I said that I thought a lage part of the development in Wyoming might possibly have been made under the riparian doctrine I did not mean that such development could have been made under what is known as the extreme riparian doctrine that has prevailed in many of the Eastern and Middle States. I do not think it could. I do not know that I would consider the modified riparian doctrine as in any degree equivalent to the doctrine of prior appropriation. As I understand the modern riparian doctrine to allow a reasonable use of the water by all of the riparian owners on the stream, it appears to me to give them equal rights irrespective of the time they began to use it. Thus it would have the effect of making them share among themselves any shortage of water in a dry season. I understand by the extreme riparian doctrine that prevails in many of the Eastern and Middle States that it requires the upper riparian owner to let the water flow undiminished in quantity and unimpaired in quality to all the lower riparian owners, subject only to what are called the natural and necessary uses—domestic uses, the watering of cattle, etc.—and this does not include irrigation as we understand it in the arid region. Under that doctrine irrigation in Wyoming could only be car-

ried on by sufferance or permission on the part of the lower riparian owners all the way down the stream; but aside from that it could not be used as a matter of right at all.

Gibson Clark, Cheyenne, Wyo., a practicing lawyer, on direct examination (1048), says:

I am familiar with the act of Congress known as the reclamation act, and also the act of Congress known as the Carey act. If the doctrine of riparian rights were invoked in Wyoming I do not think it would be at all feasible to make either of these acts effective. The expense of acquiring from riparian owners the right to use the water would be so great that it seems to me it would be impossible to carry out either one of these acts.

J. A. Van Orsdel, Attorney-General of Wyoming, on direct examination (1055), says:

I have heard the doctrine of riparian rights discussed, and know what the doctrine means as generally understood among lawyers and laymen. Under that doctrine I do not think it would have been possible to have brought Wyoming to its present development. The effect of the application of that doctrine upon the future development of the State would be very destructive.

I am somewhat familiar with the act of Congress known as the reclamation act, passed June 17, 1902; also the act of Congress known as the Carey act, passed August 18, 1894. In those acts the public policy of the Government is set forth to some extent in its relation to the arid lands of the western country. I should

say that the application of the doctrine of riparian rights in Wyoming would render these acts almost entirely inoperative.

A. L. Fellows, District Engineer of the United States in the Reclamation Service, on direct examination (1063), says:

> I am familiar with the doctrine of riparian rights in a general way. If that doctrine were applied in Colorado it might absolutely prevent the operation of the reclamation act. To explain the word "might" I would have to state that my view of the riparian doctrine contemplates allowing the water to pass down the river undiminished in quantity or quality, and if that were enforced it would prevent the carrying out of the provisions of the reclamation act or prevent the attainment of the objects contemplated by it.

On cross-examination, Mr. Fellows says (1063):

> We have no projects on hand at the present time in the Arkansas Valley. One reason is that we did not care to undertake any as long as this controversy was under way, which was begun before the reclamation act was passed. No projects could be reasonably begun or carried on in the Arkansas Valley until this controversy is settled, nor would we undertake any until the settlement of the controversy. We have made investigations on the Arkansas River, but have determined on no projects. We have not determined upon any construction whatsoever, nor seriously considered it, until this controversy is settled, and our investigations are now being held up on that account.

See also testimony of Miguel A. Otero, governor of New Mexico (1076–8); Thomas B. Catron, former delegate to Congress from New Mexico (1091, 1095); R. E. Twitchell, attorney at law, New Mexico (1097–8); Wendell M. Reid, District Engineer in the Reclamation Service (1113–15); William G. Hamilton, Roswell, N. Mex. (1125, 1126, 1129); Francis G. Tracy, President of the Pecos Irrigation Company, Carlsbad, N. Mex. (1133, 1134).

J. J. Hagerman, of Roswell, N. Mex., former President of the Pecos Irrigation and Improvement Company, on direct examination (1149), says:

> I have given some thought and study to the doctrine of riparian rights, and it would have been impossible to have made the development which has been made in Chaves and Eddy counties under the application of that doctrine. If this doctrine were invoked it would stop future development in this [Pecos] valley. As a matter of fact it would be a physical impossibility in most places in this valley to irrigate any land at all if you were confined to the first 40 of a section or the second 40 of a section back from the river. I know of no places along the river where you could do any irrigating. If you were confined to a little strip of land it would make irrigation impossible, because no one could afford to put the dams in the river that would be necessary to raise the water high enough to get it onto lands in such small area.

B. S. Rodey, Delegate in Congress from New Mexico (1157), says:

> If the irrigated area were confined to lands lying near or adjacent to the stream, say the first or second forty, it would render future development small. It would consist only of little ribbons of land along the streams. It would stagnate it, practically. And if they were confined to the lands immediately adjacent to the stream it would thwart the main purpose of the reclamation act of Congress of June 17, 1902.

The Supreme Court of the Territory of Utah (*Stowell* v. *Johnson*, 26 Pac. Rep., 291), in speaking of the doctrine of riparian rights, says:

> If that had been recognized and applied in this Territory, it would still be a desert.

The Supreme Court of Arizona, in *Clough* v. *Wing* (17 Pac. Rep., 453, 455–456), says:

> The right to appropriate and use water for irrigation has been recognized longer than history and since earlier than tradition * * * the oldest method of skilled husbandry, and probably a large number of the human race have ever depended upon artificial irrigation for their food products. The riparian rights of the common law could not exist under such systems; and a higher antiquity and better reason and more beneficent results have flowed from the doctrine that all right in water in nonnavigable streams must be subservient to its use in tilling the soil.

Testimony was also introduced to show that the doctrine laid down by the Supreme Court of the State

of California in *Lux* v. *Haggin*, *supra*, had not been observed, and that if said doctrine had been strictly enforced it would have practically prevented any future development along irrigation lines.

Theodore A. Bell, of California, among other things says, in effect (1177), that the strict application of the doctrine in that case "would have interfered with the future development of the State."

J. C. Needham, member of Congress from California, says, in respect to the doctrine laid down in *Lux* v. *Haggin* (1204), that it—

> has been departed from a great deal, because when that decision was rendered we did not realize the value of water, and as the irrigated area grew the people realized that they could not follow that doctrine strictly and develop as they ought, and consequently the decision itself has been next to reversed. It has been practically reversed by the Supreme Court itself, and nearly every subsequent decision, by implication at least, in the language of the court, has disregarded the decision. The doctrine of prior appropriation and the application of water to beneficial use is in effect the doctrine that is now in force in California, practically, and that is illustrated in our Wright law which the legislature has enacted.

George H. Maxwell, among other things, says(1166):

> In respect to the question as to whether the doctrine of riparian rights in the strict sense is enforced in California with respect to the waters of the streams in that State, I should say no, although we have some decisions there which have been based upon the riparian

> doctrine, which are unfortunate, to say the least, for the welfare of the State, and which I think were wrongly decided and will eventually be reversed. The particular cases I refer to are the cases of *Hargrave* v. *Davis* and *Bathgate* v. *Irvine*. In regard to the case of *Lux* v. *Haggin*, that case has been very much qualified and I never interpreted the decision in that case as going as far as some people did. A curious feature about the development of the law of water in California has been that in the early decisions the question of the relative rights of use received comparatively little consideration. * * * The last leading case there, the case of *Katz* v. *Walkinshaw*, to my mind, is a milepost on the road that is going to guide us in the future in the right direction, and that practically put the law there on the right basis, which is that the riparian law of England in its application to California must be interpreted in the light of the physical conditions that exist there, and that being done, the question becomes one of use, whether the basis of the right is riparian ownership or appropriation.

Elwood Mead, in speaking of the case of *Lux* v. *Haggin*, says (1378–1379):

> I know from my investigations and a study of conditions in California that the decision of the court of that State in this matter has not been followed practically by the farmers and irrigators there. The original decision in *Lux* v. *Haggin* was not acquiesced in. There were a great many canals completed before it was

rendered, and a great many thousands of acres of land were already being irrigated. The people continued to irrigate those lands. In some cases they made arrangements with the riparian landowners or the riparian landowners would not object, and in that way they averted the application of the doctrine. In order to provide for the continuation of development, they passed what is known as the Wright Act. The evasion of that decision was not its entire purpose, but that was an important purpose of that act, by which all of the lands or large tracts of land along the streams were combined in one municipal organization, and in that way dissenting riparian appropriators were brought into the organization, and they avoided interference with their irrigation and use of the water through that. When the doctrine was invoked the decisions of the court interpreted the doctrine in a way that practically made the riparian proprietor an appropriator having prior rights to the use of the stream, and some of those decisions now have gone so far as to include among riparian lands all of the lands within the drainage of the stream.

That the public arid lands can not be reclaimed, nor the policy of the Government relative thereto be carried out, if the "California doctrine" is enforced, is further shown by recent legislation of some of the States whose courts had previously approved said doctrine, viz:

The legislature of the State of Washington, by an act approved March 4, 1905 (Sess. Laws, 1905, 180–4),

made provision for the carrying into effect in that State of the provisions of the so-called national reclamation act.

The legislature of the State of Oregon, in February, 1905 (Sess. Laws. Oreg., 1905, 401–6), passed an act making provision for the same purpose.

The legislature of the State of Montana, in which State the "California doctrine" was approved, by act approved March 4, 1905 (Sess. Laws, Mont., 1905, 184), made provision for the appointment of an irrigation commission "to prepare a revised irrigation code adapted to the needs of Montana," and $500 was appropriated to pay the expenses of said commission.

The legislature of the State of North Dakota, by act approved March 1, 1905 (Sess. Laws, N. Dak., 1905, 44–60), adopted an "irrigation code." By section 1 it is provided that all waters within the limits of the State belong to the public, except navigable waters, "subject to appropriation for beneficial use." Section 2 provides, among other things, that priority in time should give the better right. Section 3 provides for the exercise of the right of eminent domain in furtherance of irrigation enterprises.

The legislature of the State of South Dakota, by act approved March 3, 1905 (Sess. Laws, 1905, 201–215), adopted an "irrigation code." The first, second, and third sections are the same as those enacted by the legislature of the State of North Dakota, above referred to.

VI.

COMMON-LAW DOCTRINE OF RIPARIAN RIGHTS.

In his oral argument upon the demurrer, Mr. Ware, counsel for Kansas, urged that a safe rule for the court to lay down in respect to the waters of an interstate nonnavigable stream was "the old common-law rule that 'water runs, and let it run.'" (Or. Ar., 122); and that there can not be "anything safer than the old common law in its application to this case. Let the water flow down, except when it is used under such common law restrictions as are universally admitted." (Ib., 127).

In the brief upon the merits, counsel for complainant say in effect (187, 221–2) that they have the right to insist that all of the water of the river, exclusive of floods, shall flow as it was accustomed to flow, "regardless of its benefits to" Kansas or its citizens, "or the use" they "make of it;" that they are entitled to such flow even though they "never dip a foot in it, drink from it, or make any beneficial use whatever."

It is difficult to estimate in money the loss to individual persons and to the nation which would result if the above rule should be applied, while it would be impossible to depict the ruin and disaster which would follow.

When England, the home of the common law, and Canada and Australia, parts of the British Empire, realizing that the strict riparian rights doctrine is a tax upon civilization, a bar to progress, and an obstacle

to development, are each, by legislation, taking measures to control the waters of streams to the end that they may be used to develop the natural resources of their respective countries (1412-1413); when this nation, by private enterprise and public aid, has expended millions of dollars in applying the waters of natural streams to arid lands, and thereby reclaimed millions of acres thereof, created incalculable wealth, and furnished homes to many thousands of persons; and when it and its citizens are annually expending millions of dollars to bring under cultivation, by means of the waters of natural streams, vast areas of arid land, it sounds strange to hear the suggestion that the only safe and sane rule to adopt in regard to this case is that of the common law.

The necessity for a departure from the common-law doctrine of riparian rights in the interest of civilization, advancement, and development is well illustrated by Mr. Elwood Mead in his testimony (1366, 1367, 1368, 1369, 1370). Among other things, he says:

> * * * in many parts of the world water supplies are changing their character so that they are becoming one of the important industrial resources of the world and are being acquired and distributed and handled just as are other of the world's resources that have commercial value, like mines of coal and iron. * * * in all parts of the world the governments and individuals are engaged in efforts to economize in its uses and to cause it to render a greater service (1366–7). * * * Both on account of increasing values and on account of

increasing dangers we find as countries become more and more populous and civilization becomes more advanced it is impossible to leave water supplies to be utilized without some sort of regulation and control (1367). * * * It was not until the middle of the last century that countries like Austria and Germany had any general code of water laws, and in both these countries those laws have been revised once or twice since, and in every instance this revision is in the direction of a larger or more rigid direction and control by public authorities, in order to lead to more efficient use. In Switzerland up to 1902 water, while of great industrial importance and with rights to it dating back to the time of the Roman occupation, the regulation of water rights had been left to each one of the different cantons (1367). * * * In Italy, which is generally regarded, I believe, as having the most efficient administration of public water supplies in irrigation of any country in the world, the foundation of the present administration was laid in the last century when the authorities of the Kingdom declared all the public water supplies of the Kingdom state property—public property. They are administered by the state; that is, the rivers are administered as a state resource. This water is treated as a valuable property and administered as a valuable property. The Government refuses to permit any diversions from the rivers without a permit, and in the granting of the permit it doesn't simply consider the first priority of application, but the relative benefits to be derived by the public

from different applications (1368). * * * Now, similar illustrations might be made on the trend of the laws and the administration of streams in all of the leading countries of western Europe (1369). The same causes are operating in England. Originally, in England the conception of the water course—its chief utility was to carry away the surplus water supplies. It served as an outlet or drainage. The conception of water as a commodity, valuable in itself, was not supported by the conditions in England; but one of the most serious questions that confronts industrial England to-day is to devise certain means under their laws by which the growing cities can obtain adequate water supplies. This is true of Birmingham and Manchester, and it is especially true of London. The enormous growth of London, and the enormous increase in the consumption of water and the difficulty in obtaining pure-water supplies to meet that consumption, has been one of the most serious problems which has confronted that city in the last twenty years. In order to do this they have gone to the chalk hills, where the water is pure—I don't remember the exact distance; it is about an hour's ride—and have drawn very largely on the underground supplies in that section of the country. And they have drawn on those underground supplies to such an extent that two streams of considerable size have been entirely absorbed, and two years ago the city of London was engaged in litigation over the destruction of those streams and the interference with the natural water supplies of the villages along those streams.

That action, forced by necessity, is in direct violation of the doctrine of riparian rights, because the right of the riparian appropriator, under the English common law, was an inseparable attachment to the soil along the streams—an inseparable right. But not only have individual rights been taken, but all rights along certain water courses have been destroyed because of the superior necessities of a great city.

There is no single country in the world where the use of water in irrigation has reached the extent or is of greater importance than in India. It not only involves the diversion of an enormous quantity of water, but the right to make those diversions affects the lives of millions of people. The amount of money that has been invested is beyond computation; it has been going on for centuries and it is impossible to tell how much money has been invested. There is one illustration that would give some idea of it—that the amount of water that is lifted from wells there, from underground supplies alone, is greater than is used to-day in the entire United States. There is more land irrigated from wells than is irrigated in the United States to-day (1639). * * * Oh, yes, the Federal Government in its policy of erecting reservoirs in the arid region is to a certain extent imitating England in the erection of these tanks in India (1370).

Upon this subject Mr. Farnham, in his work on "Waters and Water Rights," at pages 1895, 1895a, says:

> Experience has demonstrated that a controlled water supply is equal, if not superior, in importance to either a fertile soil or a favorable climate in the successful sustenance of a dense population from the fruits of the earth. Lack of fertility may be supplied, and even an adverse climate may, in many cases, be made to aid in the production of bountiful harvests if moisture can be applied to the germination of the seed and the forcing of the young plants at exactly the right time and in the right quantities.

While the court may, in some instances, resort to common-law principles (if the same are applicable) for the purpose of determining or solving a new question in respect to which there is no settled or statute law (*B. & O. Ry. Co.* v. *Baugh*, 149 U. S., 369, 372), yet it may be asked on what theory may it resort to the common-law rule of riparian rights to determine the question here presented and apply such rule in the jurisdiction of Colorado and Kansas, where such rule does not prevail.

It is a legal maxim that "a custom proceeding from certain reasonable use supersedes the common law" (Wh. Legal Max., 152).

However, there is no common law in the United States separate and distinct from the common law in the States, and it can "be made a part of our Federal system only by legislative adoption" (*Wheaton* v. *Peters*, 8 Pet., 591, 658), although "the principles of the common law are operative upon all interstate

commercial transactions, except so far as they are modified by Congressional enactment" (*West. U. Tel. Co.* v. *Call Pub. Co.*, 181 U. S., 92, 102).

Even though it be conceded that the subject-matter of this action is an "interstate commercial transaction," the rule of the common law should not be applied for the reason that Congress, by legislation, and especially by the reclamation act, has modified, if not entirely abrogated, the principles of the common law with regard to riparian rights along interstate streams.

But this court has held, in *U. S.* v. *Rio Grande Dam and Irrigation Co.* (174 U. S., 690–703) that the State had the power to change the common-law rule as to streams within its dominions, subject to the limitations therein stated. And the people of the State of Colorado, by their constitution, have not only changed that rule, but its highest court has held that such rule never applied within its boundaries. (*Coffin* v. *Left Hand Ditch Co.*, 6 Colo., 443, 447.) Upon what principle, then, may this court force upon the State of Colorado and its people views of the common law which the courts therein and the people have repudiated?

VII.

THE "CALIFORNIA DOCTRINE" OF RIPARIAN RIGHTS IS NOT SUITED TO THE CONDITIONS AND WANTS OF THE PEOPLE IN THE STATES THAT ARE PARTLY HUMID AND PARTLY ARID.

Counsel for complainant say, in effect, that the "California doctrine" has been adopted in those

States which are partly humid and partly arid, and that it is "suited to the conditions and wants of the people" therein (Kans. br., 207). Further, that the decisions of the highest courts in regard to said doctrine "are consistent and logical and may be harmonized with each other," and that "an examination of the leading cases of each of these States will show the unity of view entertained." Kans. br. 208.

We do not agree with either of the above statements.

To support their proposition in respect to the "California doctrine" being best suited to the wants and conditions of the people in the States which are partly humid and partly arid, counsel for complainant evidently rely upon certain expressions to that effect to be found in some of the decisions referred to by them on page 208 of their brief. They introduced no testimony to sustain their proposition in this regard. On the other hand, the intervenor showed by competent testimony that the proposition, as one of fact, is not correct. So far as California is concerned, this testimony has already been referred to and need not be repeated. In regard to Washington and Nebraska, Elwood Mead (1422–1423) says:

> Question. Mr. Mead, in answer to a question propounded by counsel for the State of Kansas, you stated that the doctrine of riparian rights, and the doctrine of appropriation, existed in some of the arid States; that is, in States that are partly humid and partly arid. In answer to a question propounded by coun-

sel for the State of Colorado, you stated that these doctrines are inconsistent and irreconcilable with each other in the same watershed. Now, there might be an apparent inconsistency in those two statements, and I would like you, if you can, to clear it up.

Answer. I had in mind at the time of answering those two questions different sets of physical conditions. In the State of Washington, for example, the Cascade range of mountains divides the State into two entirely different regions, climatically considered; east of the range it is arid, and irrigation is necessary, and a statute recognizing right to appropriate the water of streams for irrigation purposes was passed. On the western slope of the Cascades it is humid, exceedingly so, and there is no question as to the existence of the doctrine of riparian rights. The doctrine of riparian rights has been recognized and sustained by the courts of the State. First it was applied to the humid side; subsequently it has been applied to the arid side. They have, however, legislation that provides for the appropriation of water. Now, there, apparently, those two doctrines exist, and exist on the same stream, but as a matter of fact one doctrine prevails in one part of the State and the other doctrine in the other part of the State. Now, while in theory the riparian doctrine exists over in the arid portion of the State as a matter of fact the water is taken out without respect to riparian rights, but it subjects those who do this to a constant anxiety and expense to prevent the enforcement of the doctrine.

While it exists by virtue of a decision, it does not exist in actual practice. Now, that is the situation there. That is the actual situation. It was enforced on one stream, and if anyone goes there to-day, or as I was there three years ago, you can see four or five deserted homes in the country where the doctrine of riparian rights was applied, and the ditch that had been built and was the foundation of those homes is abandoned. Now, the menace of that situation is as to when the riparian doctrine will be put into effect, and this year there was a commission, on which there were a number of very able lawyers, submitted a draft of an irrigation code, and in connection with that code they made an argument on that question as to whether or not they would make a division in the State running along the summit of the Cascade range. They regarded it as a matter of no consequence on the wet side what doctrine prevailed. Water was a nuisance anyhow, and one doctrine would work there just as well as another; but on the eastern and arid side they desired to have the doctrine of appropriation supplant the doctrine established in decisions, and which, by the way, overruled the statute under which the ditches were built; but they finally decided to make the doctrine of appropriation general in its application and to apply to the whole State.

In Nebraska the doctrine of riparian rights is not questioned at all in the eastern part of the State. You can say with perfect certainty that it prevails in the eastern part of Nebraska, because it is the sole doctrine there. But in

western Nebraska the appropriation and diversion of water has displaced the riparian rights doctrine, or had until recently. Now, in the recent decisions of the courts of Nebraska it prevails in western Nebraska as well, but as a matter of fact it does not, because the streams of western Nebraska are controlled by a statute that was enacted with the idea that it overthrew riparian rights, as it in effect does overthrow riparian rights, because it places no limitation upon the diversions which can be made from the streams. Now, while the courts have sustained the doctrine of riparian rights and made it general in application in the State, as a matter of fact the streams in the western part of Nebraska are being used and diverted in accordance with the law that provides for their diversion under the doctrine of appropriation.

W. L. Jones (1172, 1175) says, in effect, that if the arid lands in the State of Washington could be reclaimed they would support a million people; that while the Supreme Court of the State of Washington had declared that the doctrine of riparian rights applied there, yet this doctrine has not been strictly followed, and that if followed it would retard development in the State and interfere with development already made; that there had "not been any real test of what would be the practical effect of that decision" (meaning the decision in respect to riparian rights); that "if it ever is enforced it would seriously retard development;" that "the Washington legislature is now in session and there is an irrigation bill

pending there. * * * It is for the purpose of getting the law in condition so that the reclamation act can be enforced in that State."

Such bill was subsequently passed (Laws, Washington, 1905, pp. 180–184).

Clarence T. Johnston (1027) says:

> In a State where the land of one half can be made productive only by irrigation and the other half is productive without irrigation, undoubtedly the doctrine of appropriation, if they could only recognize one, would be of the greatest benefit and the one that should prevail.

Elwood Mead (1411) says:

> It is my conviction that the second doctrine (of appropriation and application for beneficial uses) is the one best suited both to the protection of all legitimate rights and for the development of our resources in the entire United States as a whole. I do not think it is possible for the loss to what might be called riparian owners or appropriators to be as great by reason of the establishment of the doctrine of appropriation as would be the loss to appropriators by the establishment of the riparian doctrine.

In "Irrigation Institutions," by Elwood Mead, being "A Discussion of the Economic and Legal Questions Created by the Growth of Irrigated Agriculture in the West," published by Macmillan & Co. in 1903, the author says, at page 319:

> Public policy favors the use of streams on nonriparian lands. The upland areas are bet-

> ter suited to irrigation, and crops can be irrigated with less labor and less water. Locating the irrigated areas in broad, compact tracts is economical, and it secures better social and industrial conditions than is possible by restricting irrigation to riparian lands and confining homes to the banks of streams. * * * Public welfare requires, therefore, that the aristocracy of privilege conferred by the common law on riparian proprietors shall * * * be abrogated.

And, again, on pages 324, 325, he says:

> In the arid West it will not answer to give the riparian lands the sole control of streams, because this will prevent the best and largest development, and because such limitation is not warranted by any element of natural justice. The water which fills the stream does not come from lands owned by riparian proprietors. Its storehouse is in the distant mountains. The snows and rains fall, as a rule, on public land, and are as much the property of the nonriparian as of the riparian landowner. The districts where streams rise belong chiefly to the Government. The preservation of the forests upon which the perennial character of the water supply depends is looked after by the Government and paid for by the nonriparian alike with the riparian proprietors. There is no reason why the public should favor either the riparian or nonriparian landowner, but the public is vitally concerned in securing the largest and best use of its valuable resources, and this requires that the best land

> should be irrigated and water used where it can be diverted to the best advantage and made to produce the largest results.

That the people of those States where the California doctrine was declared by the courts to exist do not regard such doctrine as suited to their conditions and wants is emphasized by their efforts to abrogate the same by legislation. (See acts of the legislatures of the States of Washington, Nebraska, North Dakota, Oregon, South Dakota, and Montana, above cited and referred to.)

(1) *The California doctrine is not applicable to the Arkansas River.*

Notwithstanding the declaration in their brief upon the merits (Kans. br., 211) to the effect that they do not urge that the doctrine of riparian rights shall be extended to Colorado, it would seem that counsel for complainant do contend that at least the "California doctrine" governs the waters of the Arkansas River along its entire length in Colorado and Kansas.

Mr. Ware, formerly counsel for Kansas in this case, in his oral argument on demurrer, which was subsequently printed with the arguments of other counsel (Or. Ar., pp. 122–123), among other things, said:

> I believe if I were asked to write the decree of this court I would leave domestic purposes and mining and stock watering out of the proposition. I believe I would order the

> State of Colorado to cease from irrigating nonriparian lands, because I do not believe that Colorado has a right to use any water of that river for the irrigation of nonriparian lands. That water belongs to the States and the people, and Colorado has no right to divert it entirely from the river.

Mr. Ware, in his argument, impliedly, at least, admitted that the citizens of Colorado had the unquestioned right to appropriate the waters of the Arkansas River to irrigate riparian lands. He further stated (Ib., 116) that while it was not an easy matter to say what is a riparian right, it was not difficult to describe nonriparian land, and in this connection said:

> We conceive nonriparian land to be such land as that the drainage and the seepage will not go back to the original stream.

The present counsel for Kansas, in their brief upon the merits (Kans. br. 210), invoke the doctrine as laid down by the Supreme Court of the State of Kansas in *Clark* v. *Allaman* (80 Pac. Rep., 585). The court there quotes with approval the definition of riparian land as given by Mr. Farnham in his work on "Waters," as follows:

> All conceptions of riparian land lead to the conclusion that it is land which is tributary to and lying along a water course, and as soon as the "divide" is passed and the watershed of another stream is reached, the land can not be regarded as riparian with reference to the former stream.

Said court further states in said decision (584):

> The authorities are unanimous to the effect that the use of water for irrigation is one of the common-law rights of a riparian proprietor. * * * In all cases the use must be reasonable, and the right of each must be exercised with due regard for the equal rights of others.

The views expressed by Mr. Ware and the views of the Supreme Court of Kansas, as seen in the decision in *Clark* v. *Allaman, supra,* are fairly in accord with what is commonly understood as the "modified" or "California" doctrine of riparian rights.

The difficulty, however, of determining what is a "reasonable use" of the water for irrigation purposes as that term is employed in the decisions of those courts which have approved the "California doctrine," the uncertainty of what is meant by the term "riparian land," and the instability of the "California doctrine" itself furnish a negative to the question whether it is feasible and practicable to apply said doctrine to the waters of an interstate stream.

The above statement is made with full knowledge of the view of the United States Circuit Court for the Northern District of California, as expressed in *Anderson et al.* v. *Bassman* (140 Fed. Rep., 14). The subject-matter of that controversy was the waters of an interstate stream which had its source and flow in California (the birthplace of the "California doctrine") and thence flows into Nevada,

where the rule of priority of appropriation governs without reference to whether or not the lands are riparian or nonriparian. After reviewing a number of decisions in respect to irrigation and the laws governing the waters of streams, the court said, on page 24:

> It follows from these authorities and others that might be cited that whether the water is taken from the stream in California by the riparian owner for the purpose of irrigation, or is taken from the stream in Nevada by the appropriator for the same purpose, the right is equally sanctioned by law, and is subject to the same limitations; that is to say, the right to use the water from the stream for irrigation purposes in either State under either right must be a reasonable use, to be determined by the circumstances of each case, and with due regard to the rights of others, having the same beneficial use in the water of the stream.

An examination of that case shows the difficulty, if not the impracticability, of applying such doctrine to the waters of an interstate stream situated as is the Arkansas River.

As has heretofore been shown, witnesses for the intervenor who have made a study of the irrigation question agree in the view that the application of the California doctrine in any particular State would reduce to a minimum the amount of public land which may be reclaimed and cultivated, and would practically defeat the policy of the Government in respect to such land, and that such doctrine and the doctrine

which prevails in Nevada can not exist at the same time upon the same stream.

In *Crawford County* v. *Hathaway*, a Nebraska case (93 N. W. Rep., 781), being one of the cases relied upon by counsel for complainant to support their theory that the California doctrine should govern the waters of interstate streams, the court said, at page 789:

> Our discussion on the rights of riparian owners is extended only to those streams of water where the bed over which it flows is included within the survey of the public lands as made by the United States Government, from whom the riparian owners obtain title. Such is the character of the stream the water of which is the subject of the present controversy. In the case at bar the stream is a narrow one, ordinarily flowing but a small volume of water, the bed thereof belonging to the contiguous land owner. Whether the common-law rule fixing the rights of riparian proprietors applies to the larger streams of the State, such as may be classed as interstate rivers, and along the banks of which meander lines have been run by the Government in its survey of the public lands, presents an entirely different question, and it would seem that riparian rights would not attach to the waters of such rivers. A final determination of the question, however, is not here made, as this should be left to be decided in a proper case where the subject is fairly presented and considered after opportunity for thorough investigation, aided by the researches and arguments of counsel.

(2) *The decisions of the courts of the States where the California doctrine has been held to prevail are not "consistent and logical," and can not "be harmonized with each other," nor do they show a "unity of view."*

We have already seen that, so far as California is concerned, the decisions of the courts in respect to said question are anything but consistent and logical, and that they can not be harmonized with each other. Counsel for complainant cite *Lux* v. *Haggin* (69 Cal., 255; 10 Pac., 674) and *Gould* v. *Eaton* (117 Cal., 539; 49 Pac., 577). In the first of these cases it was held that the right to use water for irrigation purposes was limited to riparian proprietorship, while in *Gould* v. *Eaton* it was held that a riparian proprietor, "as against himself or his grantee," might "contract for the diversion of waters to nonriparian lands."

A case before the Supreme Court of the State of California, involving the right to subtract and appropriate underground waters, is that of *Katz* v. *Walkinshaw* (70 Pac. Rep., 663), where it was held, in effect (syllabus), that the riparian law of England, in its application to California, must be interpreted in the light of the facts that existed in California, and that being done, the question becomes one of use, whether the basis of the right is riparian ownership or appropriation. (Testimony of George H. Maxwell, 1167.) A rehearing was granted in this case (74 Pac. Rep., 766) and the court held (syllabus):

> Since the common-law rule that an owner of land was the absolute owner of percolating

> waters beneath the surface of his land could not be equitably applied to the State of California, by reason of its peculiar physical conditions, such rule is not adopted in such State as a part of the English common law.

[Since writing the above we have received information to the effect that, in the recent case of *Newport* v. *Temeschal Water Co.* (not yet reported), the Supreme Court of California has practically overruled the case of *Katz* v. *Walkinshaw*.]

Professor Mead, in his work on "Irrigation Institutions," in speaking of the decisions of the supreme courts of the States which undertake to apply the "California doctrine," says, at pages 322–323:

> When the users of water under these two doctrines came in conflict the courts had to settle the issues created; but as each decision dealt with a particular and often local issue, and had to be governed by the facts submitted by the parties to the litigation, they seldom lay down general principles, and are not always consistent with each other. Hence, they do not furnish a definite guide for a general doctrine or a complete basis for the settlement of future controversies. Nevertheless, it is to these decisions, rather than to the statutes, that we must go for light on the nature of water ownership in each of the States where these two doctrines now operate.

VIII.

THE "UNDERFLOW;" ITS SOURCE; WHETHER PERCOLATING WATERS OR A SUBTERRANEAN STREAM—THE LAW WHICH GOVERNS SUBTERRANEAN WATERS.

In the opinion of the court upon the demurrer it was stated that proof should be offered with respect to the question "Whether what is described in the bill as the 'underflow' is a subterranean stream flowing in a known and defined channel, and not merely water percolating from the strata below."

In response to the above direction of the court, testimony was submitted in regard to the underflow by complainant, by defendant Colorado, and by the intervenor. Counsel for complainant, in their brief upon the merits, assert that the evidence so submitted "clearly and conclusively establishes" the following probative fact (Kans. br. 183, 184):

> Third. Beneath the bed of the river, and extending to the upland on either side, is a vast stream of underground water, well defined, flowing through a stratum of coarse gravel, following the general course of the surface stream, and moving to the sea with a steady appreciable current of from five to twenty feet a day. This underflow depends upon and is fed by the surface river and not by drainage from the surrounding country. Prior to 1887 this underflow provided a subirrigation that made large crops of cereals, vegetables, and fruits in the valley with but little precipitation, and rendered the valley lands of great value until it was so far lowered as to be unavailing.

And on page 187 they assert as a proposition of law the following:

> Fifth. The underflow of the Arkansas River in Kansas is a well-defined subterranean stream, distinct from underground or percolating waters, the right to which vests in the owner of the surface, and its unlawful diversion, deprivation, or diminution is a substantial wrong for which equity will grant relief.

It is not our purpose to discuss the testimony of either the complainant or the defendants in regard to the so-called "underflow." We deem it proper, however, and consider it our duty to call the attention of the court to some of the principles of law applicable to such testimony and also to invite the court's attention to the testimony of the intervenor in respect to said underflow.

It is common knowledge that there is underground or sheet water at varying depths everywhere; and that its source is rainfall and melting snow which percolates from the surface through the soil.

Willard D. Johnson, who has devoted many years of study and investigation to this subject, says, in effect (1222), that the world around has ground or sheet waters everywhere and that the origin everywhere is rainfall.

N. H. Darton of the Geological Survey, who has also given considerable study and investigation to the subject, says, in effect (1256), that underflow water is common to the entire world and that the source is the rainfall.

F. H. Newell (1265) says:

> Sheet waters or underground waters in the arid part of the United States are similar in occurrence to those throughout the world.

It would seem to follow from the above that the burden of proof to show that the underground water in the valley of the Arkansas River in Kansas is different from the ordinary underground or sheet water found everywhere is upon the complainant.

Four of intervenor's witnesses (experts), in regard to the question of underground waters, two of whom had made special investigations in respect to the source of the underflow or underground waters in the Arkansas Valley in Kansas, testified, in effect, that these underground waters were not different from the ordinary ground waters found everywhere and that they did not depend upon and were not fed by the river except for a very narrow strip along its banks.

Willard D. Johnson, of the Geological Survey, who made a thorough investigation in respect to the underflow near Garden City, Kans., says, among other things (1222):

> There is no particular difference whatever between the sheet or underground waters in the Arkansas Valley and the sheet or underground waters of the other plains sections; that is, no difference in character. * * * I made a study with respect to the source of supply of these sheet or underground waters. That was the principal subject of my inves-

tigation in that region. From the investigations I have made with respect to this matter I would say that the origin of underground waters everywhere is rainfall.

N. H. Darton, of the Geological Survey (1256), says:

> For the last eight years I have made investigations with respect to the underground or sheet waters of the Great Plains of the arid region of this country. * * * I am preparing a report on the underground waters in the Arkansas Valley in Colorado, but have made very few observations in Kansas. I have made some in Colorado. The source of the underground waters along the Arkansas River is the rainfall and the melting snows.

F. H. Newell (1266) says:

> This underground or sheet water extends along the valley of the Arkansas River as a part of the general sheet water underlying the entire plains area. * * * I have made investigations with respect to the sheet or underground water along the Arkansas River in Colorado and Kansas. In regard to its source, as a rule it is derived most largely from local rainfall, as testified by the fact that the great body of the sheet water is at a higher level than the level of the rivers as a rule. I personally visited the Arkansas River from its headwaters at various times down to and below Wichita, and have directed the movements of field parties and visited those field parties at intervals. * * * These investigations have not been completed.

Charles S. Slichter, Consulting Engineer of the Geological Survey, who held the chair of Applied Mathematics in the Engineering College at the University of Wisconsin for nineteen years, and who had charge of work on underground waters from the time he became connected with the Survey in the year 1904, spent several months near Garden City, Kans., making investigations in respect to the amount of underground waters in and around Garden City and the source of said waters "to determine whether or not it would be practicable to recover groundwater under the reclamation act for the irrigation of lands adjacent to the river" (1335). As a result of his investigations, he testified in effect that the underground water was supplied by rainfall and melting snows, and was not fed by the river. His testimony upon the subject is very interesting and will be found in the printed transcript of the record, pages 1334 to 1362, inclusive. Among other things, he says (1340, 1341):

> I have made investigations to ascertain whether or not there was sufficient ground water to justify the Government in putting in pumping plants to raise it to the surface for irrigation purposes around Garden City. I prepared the plans of a project which proposes to take the ground waters near Deerfield and recover them by wells and put them upon the uplands. I have estimated that it is practicable to recover at that place 100 second-feet of ground water for a period of 150 days during each year. The strip that

it is necessary to use for such purpose must be 24,000 feet in length in order to recover that amount of water with a depth of 300 feet. Three hundred by 24,000 is the cross section of the underflow which it is proposed to intercept for that purpose, allowing, however, a considerable factor of safety in that estimate. This 100 second-feet of water pumped for 150 days to the surface will irrigate 15,000 acres in that country. At Garden City, 7 miles below, we expect no effect upon the ground waters from the recovery at Deerfield. The plans were especially made to reduce such changes to a minimum. It would have no perceptible effect below Garden City.

Mr. Slichter made a report in respect to the investigations above referred to, which was published in 1906 by the Interior Department, under the title "The Underflow in Arkansas Valley in Western Kansas" (Water-Supply and Irrigation Paper No. 153.)

Extracts from this report are attached to this brief, "Appendix, p. 219."

The Government is now constructing a pumping plant at Garden City, Kans., at an estimated cost of $250,000, the purpose of which is to bring to the surface from the so-called underflow sufficient water to irrigate about 15,000 acres of land in Finney County, Kans. So far as we are advised, no protest has been entered against the erection of this pumping plant by riparian landowners in the Arkansas Valley below

Garden City, and no complaint has been made by them to the effect that the taking from the underflow of sufficient water to irrigate 15,000 acres of land would cause a lowering of its level.

The source of the so-called underflow is a question which requires scientific knowledge and special study and investigation to determine. Hence the opinion of expert witnesses should have more weight than the opinions of inexperienced and unskilled laymen. (Rogers' Expert Testimony, sec. 3, pp. 6, 7; *Linn* v. *Sigsbee*, 67 Ill., 75, 82.)

The question whether subterranean waters flow in a defined channel or are merely "percolating" is a question of fact and not of law. Such waters are percolating when they pass through the ground without definite channels (Farnham on Waters, 2736). They are not percolating when, in seeking a lower level, they flow in "well-defined channels with well-defined banks" (Ib.). "Subterranean waters are presumed to be percolating," and therefore the burden of showing the existence of an underground stream of water is upon the one asserting the right to its use. (Ib.; also *Barclay* v. *Abraham* (Iowa), 64 L. R. A., 255.)

In "Irrigation in the United States," by Prof. F. H. Newell, Chief of the Division of Hydrography, U. S. Geological Survey, this subject is interestingly discussed. At page 235 the author says:

> One of the most interesting cases recently decided, bearing upon the character and ownership of the underflow, is that of the Los Angeles

River of southern California. The stream to which this name is applied appears upon the surface near the lower end of San Fernando Valley. The visible water gradually increases in volume as the valley narrows, and in the gorge or canyon by which the stream makes its exit toward the ocean it attains a considerable and fairly constant volume. The river, as shown [on an accompanying plate], appears to come from marshy ground, and might be said to have its origin here, but this water must have come primarily from the rainfall; and since the valley is relatively small, the amount which falls upon it would not be sufficient to maintain the river.

Throughout San Fernando Valley are many wells, some of them in gravel capable of yielding large quantities of water. Among the most important of these works for obtaining underground water are those of a company which purchased a large tract, tunnelled beneath the surface, and constructed infiltration galleries, from which large and valuable amounts of water were obtained. The city of Los Angeles, owning the water in the river, claimed that this large development work, while a mile or more from the visible stream, was in effect taking water out of the river, and brought suit to restrain this unlawful diversion.

The water company claimed that under the common law they had an unquestionable right to take all of the water found beneath the surface of the land which they owned, since this water flows or percolates underground in undefined channels. It was, therefore, incum-

bent upon the city to demonstrate that the water in San Fernando Valley does move beneath the surface in defined channels, and that these feed the Los Angeles River as would be done by ordinary surface streams.

To make the situation clear it will be necessary to explain the conditions a little more at length. To the north and east of San Fernando Valley is a large tributary watershed, coming from which are several streams, the most important of these being Big and Little Tejunga and Pacoima creeks. The mountains at the headwaters of these streams are high and receive a considerable rainfall. A portion of this flows in the streams and continues downward to the edge of the San Fernando Valley, where it gradually disappears in the gravel and bowlder channels or washes which extend out across the valley toward the points where Los Angeles River rises. The washes are usually dry on the surface, except in the rainy season, and thus the creeks named are not visibly connected with Los Angeles River.

It is claimed on behalf of the city of Los Angeles that the water progresses gradually beneath the surface along these washes, finally reappearing in the river to maintain the continuous discharge. The rival company's works were placed within these washes, and the assertion was made that, even though the water percolating through these gravels might ultimately reach the river, yet, since this did not flow in known and well-defined channels, there was no cause for action.

The court decided that the water traveling beneath the surface was a part of the Los Angeles River, and that these washes, well marked on the surface of the ground, indicated the presence of well-defined channels beneath the surface, these indications being confirmed by testimony based upon the depth of the water in wells and test pits. This was further supported by the analogy in the case of a pond filled with bowlders. The San Fernando Valley might be regarded as a natural basin into which streams flowed from the hills, and out of which water was discharged at the lower end. The gradual filling of this pond with débris from the mountains would not completely displace the water, but it would continue to travel beneath the surface toward points of least resistance.

If the water at the outlet is all owned or appropriated it would not be proper to permit diversions from the pond, even though this were filled with gravel in such a way as to obscure and break up the course of flow. It was held that "It makes no difference whether the onward flow is upon or below the surface, provided it is in a known and defined direction and in known and defined channels. The washes of the Tejungas and of the Pacoima are clearly cut and well defined from these streams to the Los Angeles River. In seasons of heavy rainfall these streams sometimes cut new surface channels through the sand, but for a long time they have maintained such channels through substantially the same territory." "It is this subsurface flow that supports and sustains the flow of

> the Los Angeles River, and any diversion from it * * * amounts eventually to an equivalent abstraction of the same quantity directly from the river."
>
> The fact that the testimony presented in this case has established the existence of well-defined channels underground should not be taken as implying that similar channel can be found wherever water occurs in considerable quantities beneath the surface. The topographic and geologic conditions must be thoroughly studied in order to discriminate between conditions where such channels do exist and those where the water is merely seeping or progressing slowly from point to point in broad, irregular deposits of gravel. In the latter it is usually impossible to demonstrate that there are any well-defined limits, since the gravels shade off into sands or clay, each mass of pervious material being perhaps isolated from all others or connected by overlapping layers.

The contention of counsel for complainant to the effect that the underground waters in question in the case at bar flow in a well-defined channel and are not percolating is based upon inference drawn from the testimony of some of their witnesses, for none testified directly to that effect, as an examination of the record will disclose.

The testimony of intervenor's witnesses in regard to this question is, in substance, as follows:

Clarence T. Johnston (1033):

> I have made some investigations with respect to what is called the underflow in the

Arkansas Valley, and from this investigation I would say that it is percolating water. I am confident of that. It is simply flowing water beneath the surface of the ground. I would not venture an opinion as to the source where it percolates from—whether from the stream or from rainfall.

Willard D. Johnson (1256):

As to calling this movement of the ground water "percolating water," I should say that it should not be so called. The idea of percolating—the expression conveys the idea of the movement of water through interstices that it does not fill. The ground water absolutely saturates the ground and moves as a body. You put a little water onto the ground and it percolates down through the loose ground to the ground water and there it saturates the ground. Professor Carpenter is an expert on those matters; I don't know how he would use that term. My impression is that it is water passing through loose pores which it does not completely fill, and after this water gets into the moving body of ground water that water does not percolate, it flows as a body.

Perhaps it is commonly known as percolating water as distinguished from water running in underground channels, say in limestone regions that have dissolved; it runs above the underground plane. It may run as brooks and rivers, etc., in channels, in open passageways, etc. Now, the ground water is below that, and those are streams of water running between walls and in a bed. That is different from the movement of ground water proper;

that moves as a mass. The movement of percolating water would be a great deal greater than the movement of ground water proper. It would be by gravity, you see, down through the open pores.

F. H. Newell (1284):

"Percolating waters" as I use the term are the waters which progress toward the line of least resistance through gravels or sands or other pervious strata. The ground water is percolating water; yes, sir. There is no possibility of defining its boundaries except as they are coincident with lines of gravel or clay. The direction of its flow follows the line of least resistance, which is modified by the descent or the porosity of the material.

Charles S. Slichter (1361–2):

Question. You have been asked often as to the current of this underflow. Do the ground waters through Kansas where you made your investigations have a current or flow in a channel in the way in which we speak of the current of a river or the channel of a river?

Answer. Well, the flow is in gravel—in sands—and not in caverns.

Question. Are not these waters what are commonly called percolating or ground waters?

Answer. Yes.

Question. The mere fact that they move in one general direction, coincident with the general slope of the country, does not change their character from percolating waters and what is meant by that term, does it?

Answer. In my opinion, it does.

Question. In what way?

Answer. They constitute a drainage for the country that passes in a general direction for long distances without seeking a surface drainage channel.

Question. Well, I say, that does not alter the fact of their being percolating waters, does it?

Answer. Well, I make a distinction between percolating waters and waters that drain a country in this way, myself.

Question. What is the distinction that you draw?

Answer. The distinction I draw is the distinction between waters that percolate towards a stream and form what we might call springs in the bed of the stream and waters that move on for considerable distances without seeking release or being forced to seek release in surface streams. I call one underflow waters and the other percolating waters.

Question. So far as the rapidity with which they move is concerned, these ground waters move no faster than what you denominate percolating waters, if as fast, do they?

Answer. No, sir; no difference in that respect.

Question. None of these ground waters of which you have spoken are such as can be designated underground streams or water flowing in defined channels, are they?

Answer. They are not.

Question. Then at least to that extent they are percolating waters as distinguished from waters flowing in well-defined channels or

streams either underneath the surface or on the surface of the ground, are they?

Answer. Yes.

The consideration of the rights with respect to subterranean waters separate and apart from the right to surface waters is of comparatively recent origin. While there are some old cases in England where the subject-matter of the controversy was subterranean waters, yet the courts in deciding them did not consider the question separate and apart from the question of the right to surface waters, and applied thereto the rule applicable to surface waters.

In some modern cases, both in England and in this country, these decisions have been followed, while in other cases the rule there laid down has been rejected. Hence there has arisen conflict in the judicial decisions of the courts in this country and in England in respect to the question. (See note to *So. Pac. Ry. Co.* v. *Dufour,* 19 L. R. A., 92.)

Some courts have held that no correlative rights exist between proprietors of adjacent lands with respect to percolating waters. (*Ohio Oil Co.* v. *Indiana,* 177 U. S., 190, 204, 207.) Other courts have held to the contrary. (See *Katz* v. *Walkinshaw,* 64 L. R. A., 236 and authorities there cited and note.)

(1) Where the common law doctrine of riparian rights prevails.

In those jurisdictions where the common law doctrine of riparian rights prevails the decisions of the courts therein on the question of subterranean waters

would seem to lend support to the following propositions:

(*a*) Such waters, when they flow in a well-defined channel, are subject to the same law as surface waters which flow in a well-defined channel.

(*b*) Such waters, whether they flow in a well-defined channel or merely percolate, if it be shown that they feed a surface stream, may be used reasonably by the owner of the land where found for its improvement, but may not be diverted by him to the injury of riparian lands along the stream so fed.

(*c*) Where such waters are merely percolating and it is not shown that they feed a surface stream, an owner of land where they are found may extract and make such use of them as he chooses for himself, but may not maliciously extract them nor for purposes of sale or transportation, if thereby injury is caused to an adjoining landowner through whose land such waters would percolate if not extracted.

It would seem, however, that this court has approved the doctrine to the effect that the title to percolating waters is in the owner of the land where found, and that his rights to such waters are determined by the same principle as determine rights in and to oil and natural gas. In other words, adjoining landowners have no correlative rights in percolating waters. (*Ohio Oil Co.* v. *Indiana*, *supra*.)

The complainant in this case makes no claim to the effect that the subsurface water in the Arkansas Valley

in Kansas feeds the stream, the waters of which are the subject-matter in this controversy. On the contrary, its counsel contend that said stream is the source of the subsurface water.

An interesting and instructive article in respect to "Property Rights in Percolating Waters," in those States where the common-law doctrine of riparian rights prevails and in England, may be found in volume 1, No. 8, Col. L. R., pages 506–520, wherein the leading cases upon the subject are referred to and analyzed.

(*2*) *Where the common-law doctrine of riparian rights has been modified.*

In those jurisdictions where the common-law doctrine of riparian rights has been modified, it would seem that subterranean waters of whatever character are subject to appropriation and may be reasonably used for irrigation purposes by the appropriator, but may not be made a matter of merchandise. (Wiel's "Water Rights in the Western States," secs. 77 and 78, pp. 130, 131; *Katz* v. *Walkinshaw*, 64 L. R. A., 236.) In a note to this case (p. 239) it is stated:

> In application of the doctrine of *Katz* v. *Walkinshaw* the California court has held that a riparian owner can not intercept percolating water so as to diminish the flow of a surface stream and put it to a use which the stream itself could not be applied to. (*McClintock* v. *Hudson*, 141 Cal., 275; 74 Pac., 849.) And that the owner of land has a right to make only a reasonable use of water percolating therein

for the benefit and enjoyment of his land, and can not make an excavation in his land so as to divert the flow of water from other land where the diversion is not for the benefit of his own property. (*Cohen* v. *La Canada Land and Water Co.* (Cal.), 76 Pac., 47.)

(3) *Where the common-law doctrine of riparian rights has been abrogated.*

Mr. Long, in his work on Irrigation, under the heading "Percolating Waters and Subterranean Streams," section 33, page 63, says:

> Percolating waters have ordinarily no legal existence apart from the soil in which they occur, and therefore are not subject to appropriation for irrigation or other purposes. But where waters collect or are gathered in a stream flowing underground in a defined channel, no distinction exists between such subsurface streams and streams flowing upon the surface. They are such property or incidents to property as may be acquired by grant or by appropriation, and when rights in them are so acquired the owner can not be divested thereof by the wrongful acts of another.

(4) *The law of Kansas in regard to subterranean waters.*

The legislature of the State of Kansas has enacted a statute in respect to subterranean waters, which is incorporated in sections 3631, 3632, and 3633 of the General Statutes of 1901, and which read as follows:

> 3631. *Subterranean channels.*—Waters flowing in well-defined subterranean channels and

courses, or flowing or standing in subterranean sheets or lakes, shall be subject to appropriation with the same effect as the water of superficial channels; and no person shall be allowed by drains, ditches, fountains, subterranean galleries, or other works to collect and divert percolating waters manifestly supplying such subterranean supplies, to the prejudice of any prior appropriator thereof: *Provided*, That nothing in this section contained shall be so construed as to render any person liable in damages for the diversion or obstruction of the flow of subterranean waters by lawfully excavating for cellars, or for mining, quarrying, or carrying on like works on his own lands, nor for excavating drains for draining and improving his own lands, nor so as to prohibit the proprietor of any lands from sinking wells therein, and thereby collecting the waters percolating through lands, and by means of pumps, buckets, and other appliances withdrawing the same for beneficial uses on his own land: *And provided further*, That any appropriation and diversion of subterranean waters which simply lower a water-level without in fact exhausting or seriously diminishing the actual and needful supply of any prior appropriator for domestic or other beneficial uses shall not be considered an unlawful appropriation or diversion thereof.

3632. *Not to take.*—No person shall be permitted to take or appropriate the waters of any subterranean supply which naturally discharge into any superficial stream, to the

prejudice of any prior appropriator of the water of such superficial channel.

3633. *Who deemed to have appropriated.*—Every person complying with the provisions of this act, and applying the waters obtained by means of any artesian well to beneficial uses, shall be deemed to have appropriated such waters to the extent to which the same shall be so applied within a reasonable time after the commencement of the works, and such appropriation shall have effect as of the day of commencement of such works, provided the same is prosecuted within reasonable diligence; otherwise, from the time of the application of the waters thereof to beneficial uses.

IX.

THE DOCTRINE OF RIPARIAN RIGHTS, EITHER IN ITS STRICT OR IN ITS MODIFIED FORM, AND THE DOCTRINE WHICH IS ESSENTIAL TO THE RECLAMATION AND CULTIVATION OF THE ARID LANDS, VIZ, THE APPROPRIATION OF THE WATERS OF STREAMS FOR IRRIGATION PURPOSES, ARE INCONSISTENT AND IRRECONCILABLE WITH EACH OTHER AND CAN NOT EXIST IN THE SAME STATE OR ON THE SAME STREAM AT THE SAME TIME.

Counsel for complainant claim, substantially, that the doctrine of riparian rights is not inconsistent with the use of the waters of streams for irrigation purposes, and that such doctrine and the doctrine of the appropriation of waters can exist in the same State and along the same stream. In their brief, at page 211, counsel for complainant say:

> The State of Kansas insists upon the preservation of the doctrine of riparian rights within

> its own territory, but the State of Kansas does not insist that the doctrine of riparian rights shall be extended over the territory of any arid State where its presence would not be suitable and where its existence has been abrogated by the constitution, the laws, and judicial decisions. We do not urge that the court should decide in this case that the common-law rule of riparian rights should be held to be in force in the territory of Colorado; we simply urge that as the injuries complained of have been inflicted within the territory of the State of Kansas those injuries should be judged by the laws of Kansas, and the remedy should be applied according to the laws of this jurisdiction, and not by the laws of the adjoining State, which has become the aggressor and has wrought the damages complained of.

We interpret the above statement to mean that along an interstate stream the doctrine of "appropriation" can be enforced in the upper State and the doctrine of riparian rights can at the same time exist and be enforced in the lower State. If this is a correct interpretation, then the citizens of the upper State have the legal right, by prior appropriation, to the waters of the stream for irrigating their lands, while the citizens of the lower State have the legal right to prevent such use. The method by which this can be accomplished counsel for complainant has failed to explain.

However, the United States Circuit Court for the Northern District of California, in *Anderson* v. *Bass-*

man (140 Fed., 14), held in effect that on an interstate stream the California doctrine of riparian rights might be enforced in the upper State and that the doctrine of prior appropriation, etc., might be enforced in the lower State.

Even though it be conceded that this is practicable, it does not follow that the reverse of the proposition is true, viz, that the doctrine of prior appropriation could be enforced in the upper State and the doctrine of riparian rights could be enforced by citizens of the lower State.

Says the Supreme Court of Utah, in *Stowell* v. *Johnson* (26 Pac., 290–291):

> The appropriation of water for the purpose of irrigation is entirely and unavoidably in conflict with the common-law doctrine of riparian proprietorship.

Mr. Works, in his publication entitled "Works on Irrigation," says, at page 17:

> It must be conceded that the right of appropriation is inconsistent with and antagonistic to riparian rights. The two can not exist together and participate in the benefits of the use of the waters of the same stream.

Says Mr. Elwood Mead in his testimony (1415):

> The doctrine of riparian rights and of prior appropriations are antagonistic. They can not exist together. One places no limitation on the places where water can be used and the other places rigid limitations. The methods of acquiring titles to water and the whole

> methods of administration are entirely different. It is simply impossible for the two doctrines to operate together in the same drainage area.

Louis G. Carpenter (772) says:

> In answer to a question by the Commissioner, I stated that I thought the California courts had recognized riparian rights in the first place and then found that they simply could not apply them in an arid country, as part of their State was. I do not know that I am clear as to what the modified riparian doctrine is, and I have never found anybody who did know. I do not know of any form that is generally recognized, and I have never in my experience met any lawyer or irrigator who could tell what the courts mean by the modified riparian rights doctrine.

However, there is another authority in support of the contention of intervenor in this respect, which counsel for complainant at least should be willing to accept. We refer to complainant's brief filed in opposition to Colorado's demurrer, at page 69, where it is stated as follows:

> The law of appropriation and of riparian rights stand side by side. They do not overthrow, but they supplement, each other. They are both needed, and Congress never intended anything contrary. This is true because the two may never exist together in the same place, and where the one may exist the other could have no application, and each remains separate, distinct, and complete.

X.

THE DOCTRINE THAT A STATE, BY REASON OF ITS SOVEREIGNTY, HAS "PLENARY AND EXCLUSIVE RIGHT AND POWER TO CONTROL AND REGULATE THE USE OF NONNAVIGABLE WATERS WITHIN ITS BOUNDARY," WOULD, IN A GREAT MEASURE, PREVENT THE RECLAMATION AND CULTIVATION OF THE PUBLIC ARID LANDS, AND, TO A LARGE EXTENT, DEFEAT THE POLICY OF THE GOVERNMENT IN RESPECT THERETO.

In its answer to the amended bill of complaint, defendant Colorado alleges, among other things, as follows (80, 81):

> That being so sovereign within its own territory, this defendant has the plenary and exclusive right and power to control and regulate the use of nonnavigable waters within its boundaries, including nonnavigable rivers and other streams, and that it has never surrendered this sovereign power over such waters, rivers, and streams, nor delegated such power, nor any portion thereof, to any other sovereignty, either National or State.
>
> * * * * *
>
> And this defendant respectfully represents that this honorable court is without power or jurisdiction to deprive this defendant by judicial decree, or otherwise, of any of its attributes or rights of sovereignty acquired and retained by it as one of the States of the Union, or to impair the same without its consent. That this defendant, the State of Colorado, out of respect for this honorable court, and in respectful consideration of the claims of its sister State, Kansas, makes full answer to the bill of complaint of said State of Kansas as herein-

> after set forth, but in so doing the State of Colorado does not waive any of its sovereign rights or consent that the same or any part thereof may be destroyed or impaired.

In its petition of intervention (239) the Government alleges that the aforesaid contention on the part of the State of Colorado, if sustained, "would permit said State to assert an absolute dominion over and a sole ownership of the waters within said State flowing within the natural beds of the Arkansas River and other interstate streams; would allow it to authorize its inhabitants to appropriate and use all of said waters to the damage of prior appropriations in adjoining and other States through which said interstate streams extend, irrespective of whether such prior appropriators were individuals, States, or the United States;" further, that said contention, if sustained, would prevent the settlement and sale of the arid lands belonging to the United States, and especially those within the watershed of the Arkansas River west of the ninety-ninth degree of west longitude.

The only reference made to the aforesaid defense by counsel for the State of Colorado in their brief is found on page 346 thereof, and is as follows:

> We have deemed it unnecessary, in the present aspect of this case, to discuss the extent of exclusive sovereign control possessed by the State of Colorado.

Of the other defendants on whose behalf briefs have been filed, the Colorado Fuel and Iron Company

alone insists upon the above as a defense (C. F. and I. Co.'s brief, 98, 119). It will be noticed that this defense is not raised by the answer of said company.

It is our purpose at this time to show from the evidence what would be the effect of such a doctrine if applied in the arid region, leaving the question whether such doctrine is sound to be discussed hereafter in connection with the questions in respect to the law governing the waters of interstate streams.

F. H. Newell (1274) says that if the State in which an interstate stream rises should persist in taking all of the water before it reaches the State line, this would, of necessity, destroy the irrigation possibilities in the lower State so far as they are dependent upon the waters of the river that come from the upper State. Mr. Newell further says:

> We, in the administration of the reclamation service, have tried to avoid the difficulties [arising out of the waters of an interstate stream] and are vitally interested in securing the establishment of a principle on which we can take up these questions in the future. If it should be established that the upper State should have the right to take all of the water of an interstate stream that falls within her borders, it would necessitate a readjustment of many of these projects and in some cases an abandonment of lands, which, as to low altitude, are perhaps a little better situated climatically, and it would practically contract the application of the reclamation act to those upper States so far as the physical possibilities extend.

Mr. Elwood Mead says (1419):

> There are places where the establishment of the State line doctrine would undoubtedly greatly simplify irrigation development and work the least injury; on the other hand, there are cases where the refusal to establish that doctrine would work such an injustice that I am sure it would never be permitted.

Clarence T. Johnston (1022, 1026) says that if all the waters in the streams which rise in Colorado and flow in Wyoming should be appropriated and used in Colorado, this would ruin the development already made in Wyoming along these streams and prevent any further development.

Gibson Clark (1050) says that there are about 200,000 acres of land irrigated in Wyoming from the waters of the Laramie River, which rises in Colorado; that the greater part of this land would become absolutely arid and incapable of supporting anything if all the waters were taken out of the river in Colorado.

George H. Maxwell (1167) says that if the State which is the source of an interstate stream should take all the waters of that stream it would have the effect of destroying the irrigation industries along the stream in the lower State and would destroy all the agricultural development depending upon irrigation in that State; that such course would, also, in his judgment, render the national irrigation act practically inoperative.

Francis E. Warren (1291) says that the reclamation act, in order to be successful, must jealously

guard the right of priority in the use of water, regardless of State lines.

Joseph M. Carey (1328) says:

> It is impossible for us to develop this western country unless the priority of the appropriation of water is acknowledged. We can not get along unless that is done, because who is going to put their money into these irrigation projects if within one week after they have appropriated the water somebody who happens to be just over the line in another State can divert that water for some other use or purpose?

Other witnesses were called in respect to this question, each of whom testified in substance and effect as above, viz: Nellis E. Corthell (1034), S. C. Downing (1045), M. R. Johnston (1059), Walter B. Dunton (1070), Miguel A. Otero (1076, 1077), Luther Foster (1081, 1082), Thomas B. Catron (1092), R. E. Twitchell (1097, 1099), Pedro Perea (1107), Solomon Luna (1109), and Frank W. Mondell (1182).

In this connection, the following language contained in an opinion given by George B. French and Jeremiah Smith, who acted as counsel to advise the State of New Hampshire on the constitutionality of a proposed act of the State of Massachusetts for the benefit of the city of Boston, for the diversion of waters of the Nashua River, an interstate stream rising in Massachusetts and flowing thence into New

Hampshire, is pertinent (Harvard Law Review, Vol. VIII, 138, 149–150):

> Let us look at the consequences of conceding to each State the full power of sovereignty supposed to be now claimed for Massachusetts. Consider, first, the consequences in respect to dealings with foreign nations; second, the consequences with respect to dealings with sister States.
>
> If each State possesses this full sovereignty, it may at any time do acts which will surely embroil itself in war with foreign nations, a war which may result disastrously and may involve other States in international difficulties. Both the border States and the seaboard States would be peculiarly liable to such troubles, and the Constitution was framed with the express view of preventing such occurrences. The inadmissability of this claim of sovereign power on the part of a State is clearly pointed out by Judge Story. "The States, as such, are not known in our intercourse with foreign nations, and not recognized as common sovereigns on the ocean. And if they were permitted to exercise criminal or civil jurisdiction thereon there would be endless embarrassments arising from the conflict of their laws, and the most serious dangers of perpetual controversies with foreign nations. In short, the peace of the Union would be constantly put at hazard by acts over which it had no control and by assertions of rights which it might wholly disclaim."
>
> Equally alarming consequences will result

> from the doctrine that a State may, with impunity, authorize aggressions upon the property of the citizens of a sister State. If it be established that the agents of the authorizing State can not be called to account in the Federal courts for their acts, then, in all cases of serious injury, one of three results must follow: Either (1) the assailed State must submit to gross injustice; or (2) laws will be passed of a retaliatory nature, such as were actually passed by three States "during the steamboat controversy," and which "threatened the safety and security of the Union;" or (3) the injured State must resort to the right of revolution, secede from the Union, and go to war with the aggressive State.

While counsel for Colorado in their brief upon the merits do not discuss, yet they do not abandon, the claim set forth in the answer of their client to the effect that the State, by reason of its sovereignty, "has the plenary and exclusive right and power to control and regulate the use of nonnavigable waters within its borders, including nonnavigable rivers and other streams;" and the Colorado Fuel and Iron Company, with persistence and ability, insists that such claim is well founded. (C. F. and I. Co. br., 98–119.) For convenience, we will hereafter refer to this claim as the "Colorado doctrine."

If Colorado were an independent nation, such claim would seem to be tenable. (21 Ops. Attys. Genl., 274.) Counsel for Kansas, however, insist, in effect (Kans. br., 188, 251–255), that even if Colorado were an independent nation, the contention of its counsel

with respect to the right of the State "to divert all the waters of the Arkansas River" is untenable. Upon this question the precedents and authorities seem to be against the position of counsel for complainant, as will appear from what follows.

October 21, 1895, the Mexican minister addressed a communication to the Secretary of State, Mr. Olney, in which the former complained of the citizens of the United States diverting and using for irrigation purposes the waters of the Rio Grande within the United States, whereupon Mr. Olney requested from Attorney-General Harmon, an answer to the following question, (21 Ops. Attys. Genl., 275):

> By the principles of international law, independent of any special treaty or convention, may Mexico rightfully claim that the obstructions and diversions of the waters of the Rio Grande in the Mexican minister's note referred to, are violations of its rights which should not continue for the future, and on account of which, so far as the past is concerned, Mexico should be awarded adequate indemnity?

After reviewing the authorities in regard to the above question and making his deductions therefrom, the Attorney-General, in his answer thereto, concluded as follows. (Ib., 283):

> In my opinion, the rules, principles, and precedents of international law impose no liability or obligation upon the United States.

The opinion is based upon the fundamental principle that "every nation, as against all others, within its own territory," is absolutely sovereign. (Ib., 281.)

It follows from the above that if Colorado, instead of being a sovereign State of the Federal Union, were a sovereign nation, it could do as it saw fit with the waters of the Arkansas River within its own territory; and if Kansas were a sovereign nation and injured by the use of the waters of the river in Colorado and the latter State would persist in diverting and using said waters or refuse to make adequate compensation to Kansas, the latter's only resort would be an appeal to the sword, and, if successful, it could compel Colorado to permit the waters of the river to flow undiminished and unaffected into Kansas. In other words, Kansas, as against Colorado, could, by force of arms only, enforce the law of riparian rights in respect to the waters of said stream.

But the State of Colorado does not have the status of an independent nation. In *New Hampshire* v. *Louisiana et al.* (108 U. S., 76, 90) the late Chief Justice Wàite, delivering the opinion of the court, among other things, said:

> All the rights of the States as independent nations were surrendered to the United States. The States are not nations, either as between themselves or towards foreign nations. They are sovereign within their spheres, but their sovereignty stops short of nationality. Their political status at home and abroad is that of States in the United States. They can neither make war nor peace without the consent of the National Government. Neither can they, except with like consent, "enter into any agreement or compact with another State."

The question arises whether Colorado as a State has the same power and control over the waters within its borders as an independent nation over the waters within its borders. This question does not seem to have ever been raised in this court, although it appears that it was involved in *New York* v. *Pine* (185 U. S., 93). In that case there was presented the question of the right of an upper State in which the common-law doctrine of riparian rights prevails to authorize the diversion of the waters of the stream therein where such diversions resulted in damage to riparian lands in a lower State having the same doctrine, and the United States Circuit Court of Appeals for the Second Circuit denied that the upper State had such right. (*Pine et al.* v. *Mayor, etc., of New York*, 112 Fed. Rep., 98.) This case was brought to this court on certiorari and resulted in a reversal (185 U. S., 93.) However, it does not appear that in either was the question raised in respect to the right of a State, by reason of its sovereignty, to control and do as it saw fit with the waters of nonnavigable streams within its borders. Evidently the counsel representing the city of New York in the above case did not think there was any force in such claim, and the fact that neither of the courts which passed upon the case made reference to any such claim would seem to indicate that neither considered the point worthy of consideration. No authority can be found to support such a proposition, while the same has been disapproved by several courts, among them the United

States Circuit Court for the District of Colorado. (*Hoge* v. *Eaton*, 135 Fed. Rep., 421.)

See also—

Howell v. *Johnson*, 89 Fed. Rep., 556.
Perkins County v. *Graff*, 114 ib., 441.
Morris v. *Bean*, 123 ib., 618.
Miller & Lux v. *Rickey et al.*, 127 ib., 573.
Anderson v. *Bassman*, 140 ib., 10.
Willey v. *Decker*, 73 Pac. Rep., 210.

While neither Kansas nor Colorado ever was sovereign, even in the sense that each of the original States was sovereign, yet both came into the Union on an equal footing with each of the original States, and it would appear to be unquestionable that each of them, by assenting to the Federal Constitution and becoming a member of the Union, agreed not to adopt any law the enforcement of which would work injury to the rights of any other State or its people, or to the citizens of any other State, or to the United States as a nation, or its property. (*South Carolina* v. *Georgia*, 93 U. S., 4.) Each State, however, is sovereign to the extent that it may adopt any law necessary to the development of its resources and for the protection of its citizens in their personal and property rights; and this court has held (*U. S.* v. *Rio Grande Dam and Irrig. Co.*, 174 U. S., 690, 703.) that, to this end, a State may, by legislation, permit the diversion and use of the waters of streams within its borders for irrigation purposes, subject, however, to the following limitations:

First. That in the absence of specific authority from Congress a State can not by its legis-

> lation destroy the right of the United States, as the owner of lands bordering on a stream, to the continued flow of its waters; so far at least as may be necessary for the beneficial uses of the Government property. *Second.* That it is limited by the superior power of the General Government to secure the uninterrupted navigability of all navigable streams within the limits of the United States.

When the Constitution was framed it was anticipated "That a State administering its affairs with prime regard to its own interests should sometimes displease and even damage a neighbor." (Columbia Law Review, vol. 2, p. 299.)

In connection with the question of sovereignty, the defendants insist that the claim based thereon is strengthened by section 5, Article XVI, of the constitution of the State of Colorado, which counsel argue was sanctioned by the Government when said State was admitted into the Union, viz:

> The water of every natural stream, within the State of Colorado, is hereby declared to be the property of the public, and the same is dedicated to the use of the people of the State, subject to appropriation as hereinafter provided.

The force and effect of this section does not seem to have been passed upon by the Supreme Court of Colorado. Judge Hallett, on February 27, 1905, however, at the time United States district judge for the district of Colorado, in *Hoge et al.* v. *Eaton* (135 Fed. Rep., 411, 414), among other things said:

> Between States dwelling in peace and concord, as are the States of our Union, the equal right of the inhabitants of each State to the waters of intersecting streams must always be recognized. Water is essential to human life in the same degree as light and air, and no bounds can be set to its use for supplying the natural wants of man other than the mighty barriers which the Creator has made on the face of the earth.

The State of Wyoming has a provision in its constitution similar to said section 5, viz, section 4, Article VIII, which reads:

> The waters of all natural streams, springs, lakes, or other collections of still waters within the boundaries of the State, are hereby declared to be the property of the State.

In *Willey* v. *Decker* the Supreme Court of Wyoming had under consideration the above section 5, and among other things said (73 Pac. Rep., 221, 222):

> The obvious meaning and effect of the expression that the water is the property of the public is that it is the property of the the people as a whole. Whatever title, therefore, is held in and to such water resides in the sovereign as representative of the people. The public ownership, if any distinction is material, is rather that of sovereignty than proprietary. * * * That ownership, however, is subject to a particular trust or use specially defined in the statutes and in the constitution. And that trust or use, in the absence of statute, is just as prominently and intrinsically at-

> tached to such public ownership. The waters are held subject to appropriation for beneficial uses. And we have endeavored to show that the right of appropriation is not, in the absence of statute at least, restricted locally, nor by State lines. The trust is to be considered as coextensive with the right on which it rests. Upon the general principles governing such appropriation we perceive no reason, if the same be not prohibited by statute, why the owner of lands in another State may not at a point in this State lawfully divert the water of a stream flowing in both States and conduct such water upon his lands for their irrigation and thereby secure a valid water right. There is nothing in the essential character of the trust or use for which the waters are held by the public that, in our judgment, prevents the acquirement of a water right on such a stream in that manner, provided the appropriator is able to comply with the statutory provisions regulating and controlling the appropriation and diversion of the public waters.

As tending to show how the people generally in Wyoming regard such provisions of State constitutions, intervenor introduced three of the leading lawyers and prominent citizens of Wyoming, who testified as follows:

Gibson Clark, one time Associate Justice of the Supreme Court of Wyoming, and later United States Attorney for said State, said, among other things (1049):

I have paid some attention to this present controversy between Kansas and Colorado. I know of the contention that Colorado makes—that as a sovereign State she owns the water because of a provision in her constitution. Wyoming has a similar provision in her constitution, practically. The Wyoming people do not claim that they are entitled to all the waters irrespective of prior appropriations beyond the State line. I think the consensus of opinion among lawyers of experience in Wyoming—and there has been some expression, perhaps something a little more than that, in one decision of our supreme court—to the effect that the practical effect of the declaration in our constitution—the declaration on the part of the people of the State that the State was the owner of all the waters flowing in natural streams or in lakes, etc.—that its practical effect was to declare that the waters of these natural streams were simply *publici juris*, and that the State had over those waters the same right for the purposes of irrigation, its appropriation and distribution, diversion, etc., the same rights which the State had over the navigable streams under the rule of the common law. No; we never believed and we do not now believe that that mere declaration in our constitution gave to the State or was the assertion on the part of the State of a property right in the water such as the State acquires in or to lands which, for instance, had been granted to it by the Government or buildings which have been erected on such land or anything of that sort, but simply

> that it gives the State the right to control these waters so far as they may be applied to beneficial use.

J. A. Van Orsdel, former Attorney-General for the State of Wyoming, afterwards an Associate Justice of the Supreme Court of that State and now an Assistant Attorney-General of the United States, among other things said (1056):

> I am familiar with the constitution and the laws of Wyoming, and as to the ownership of water, there is a similar provision in the Wyoming constitution to that in the constitution of Colorado. I do not think it is a correct construction of the constitution of Wyoming, nor is it a construction that is now generally held, that if parties in the western part of Nebraska had appropriated certain waters of the North Platte River or any other river flowing from Wyoming into Nebraska, Wyoming or any of its citizens would have a right to subsequently appropriate all of the waters of those streams by virtue of her constitution or her laws.

Joseph M. Carey, at one time United States Attorney for the Territory of Wyoming, afterwards an Associate Justice of the Supreme Court of said Territory and subsequently a Delegate in Congress from said Territory, and later United States Senator from the State of Wyoming, among other things, said (1328):

> Our constitution was not framed with the intention of taking the water away from somebody else after they had appropriated it, al-

> though the lower appropriator might have been located in the State below. No, sir; when our constitution was framed and when our State has developed in all its resources, as I have described it, it has not been upon the theory that that State or a citizen of that State could, by virtue of its constitution, now claim to own and control all of the waters that rise in our State solely by virtue of State rights or State sovereignty. The whole theory of it is that prior appropriation of water, of course, gives the party the right—the man who appropriates it—gives him the right in the water forever for that purpose, regardless of State lines.

Considerations of comity, however, would seem to estop Colorado from denying to the citizens of Kansas the same right to the waters of the Arkansas River which it claims for its own citizens, which is that under the constitution and the laws of the State water may be taken from the Arkansas River for irrigation purposes, and that he who is prior in time is prior in right.

Upon this question the Supreme Court of Wyoming in *Willey* v. *Decker* (73 Pac. Rep., 222) says:

> Moreover, a desirable comity between the States within whose respective dominions the same stream may flow, and a due regard by each for the rights of the residents and land owners in the adjoining State, would seem to require a liberal view of this matter.

See also *Rossmiller* v. *State* (114 Wis., 169; 89 N. W. Rep., 839), where it was held, among other things,

that the legislature could not declare that "ice formed upon meandered lakes of the State is the property of the State." In this connection the court said (841):

> The legislature has no such arbitrary power, under our constitutional system, as that of changing the nature of the ownership of property by its mere fiat. It can no more accomplish that result in that way than it can change the laws of nature by legislative declaration.

As heretofore seen, the evidence of the Government's witnesses shows that should the Colorado doctrine be strictly enforced in Colorado in respect to the waters of the Arkansas River, irreparable injury would result to the prior appropriators of the water of the river in Kansas; further, that by the enforcement of such doctrine the policy of the General Government in respect to its arid lands in the State of Kansas would be interfered with, if not entirely defeated With such results following the strict enforcement of such doctrine, such enforcement would seem to be a violation of the implied agreement of Colorado with the State of Kansas and with the United States when Colorado accepted and complied with the enabling act of Congress under which it became a member of the Federal Union.

XI.

THE LAW IN REGARD TO THE WATERS OF NONNAVIGABLE INTERSTATE STREAMS.

From what has preceded, the question naturally and logically arises, What is the law in regard to the waters of a nonnavigable interstate stream which

rises in and flows through a State where the doctrine of riparian rights has been abrogated, and flows thence into and through a State where such doctrine prevails?

This is the crucial and important question in this case. It is of first impression in this court. Upon its solution depends the continuation of the present prosperity and future growth and development of the arid region of the United States, generally speaking; also of the success of the policy of the Government in respect to its arid lands, as a glance at the map will show that there is scarcely a stream of any importance in this region which is not interstate.

(1) *Salus populi est suprema lex.*

While there is no common law of the United States, yet the Federal courts may resort to its principles in the solution of new questions upon which there is no statute or settled law. And in a case like the one at bar, involving a question so novel and important, the court "should * * * find the ruling principle in * * * a general law governing interstate relations" and within the maxim "the welfare of the people is the supreme law." And in determining the question involved the court would seem to be "unhampered by any limitation save such as may inhere in the nature of the States, or be imposed by the Federal Constitution. It may draw inspiration from common, civil, international, and public law at discretion." (See article in Columbia Law Rev., v. 2, p. 307.)

In the case of *B. & O. Railroad Co.* v. *Baugh* (149 U. S., 368, 372) this court used the following language:

> Established rules are always regarded by the Federal courts * * * as authoritative declarations of what the law is. But where the law has not been thus settled it is the right and duty of the Federal courts to exercise their own judgment, as they always do, in reference to the doctrines of commercial law and general jurisprudence.

In *Katz* v. *Walkinshaw* (64 L. R. A., 236, 248) the Supreme Court of California, in speaking of the common law, says:

> The true doctrine is that the common law by its own principles adapts itself to varying conditions, and modifies its own rules so as to serve the ends of justice under the different circumstances.

And in *Morgan* v. *King* (30 Barb., 9, 16) the court says:

> We are not bound to follow the letter of the common law forgetful of its spirit; its rule, instead of its principle. A rule of law applicable to the fresh-water streams of England may be wholly inapplicable to fresh-water streams in this country of the same nature and character, because of different capacity, or because the adjoining country may furnish a commerce for them unknown in England, and yet be subject to the same principle. If so, the common law modifies its rules upon its own principles, and conforms them to the wants of the community, the nature, character, and

capacity of the subject to which they are to be applied.

Where the reason for the rule of the common law on any particular subject ceases, the rule itself ceases. The Supreme Court of Connecticut in *Beardsley* v. *Hartford* (50 Conn., 541, 542), says:

> It is a well-settled rule that the law varies with the varying reasons on which it is founded. This is expressed by the maxim "*cessante ratione, cessat ipsa lex.*" This means that no law can survive the reasons on which it is founded. It needs no statute to change it; it abrogates itself. If the reasons on which the law rests are overborne by opposing reasons, which, in the progress of society, gain a controlling force, the old law, though still good as an abstract principle, and good in its application to some circumstances, must cease to apply as a controlling principle to the new circumstances.

Applying the above principles to the present case, it would seem that the judgment of the court should be exercised in favor of that rule which will produce the greatest good and at the same time occasion the least injury. What is that rule? In our opinion it is not that "Water runs; let it run," but that "Water irrigates; let it irrigate." In other words, that in the arid region the waters of streams, State and interstate, may be appropriated and used to irrigate the lands within the watersheds thereof, leaving, however, sufficient in, or returning sufficient to the bed of the streams for domestic, household, and stock

purposes, and that he who is prior in time in the actual appropriation of the water and continues to apply the same, is prior in right, irrespective of State lines and irrespective of ownership, riparian or otherwise, if within the watershed of the streams from which the water is taken.

In our opinion, there is nothing in the Federal Constitution that would prevent the court from applying the rule above stated. Like the common law, the Constitution, by its own principles, adapts itself to varying conditions. In this connection, Mr. Hannis Taylor in an article published in "The Green Bag," Volume XVII, pages 564–565, says:

> Nothing has been more remarkable in the history of our Federal Constitution than the ease with which it has adapted itself to the ever-increasing wants of a rapidly swelling population, continually organizing new systems of local government beyond our original limits. When, during Jefferson's second term, the application of steam to navigation was made by Robert Fulton, a revolution was wrought in the commerce of the country through a transition from the primitive and ineffectual means of transportation by packhorse and wagon to the methods in use to-day. A notable legal result of the change was a substitution for the ancient rule of admiralty jurisdiction, resting on the ebb and flow of the tide, of a new one better adapted to totally different physical conditions. As you all know, in Taney's time the navigable character of the river was made the test; and thus,

> by the silent stroke of the judicial pen, the admiralty jurisdiction of the Federal courts was extended not only beyond the flow of the tide in all public navigable waters, but even over the great fresh-water lakes as well, inland seas upon which fleets have encountered.

We are aware that in *Sturr* v. *Beck* (133 U. S., 541, 551) this court said that when the Government ceased "to be the sole proprietor the right of the riparian owner attaches and can not be subsequently invaded. As the riparian owner has the right to have the water flow *ut currere solebat*, undiminished except by reasonable consumption of upper proprietors, and no subsequent attempt to take the water only can override the prior appropriation of both land and water, it would seem reasonable that lawful riparian occupancy, with intent to appropriate the land, should have the same effect."

In that case, however, the proposition herein advanced by us was not raised or discussed. This is shown by the following language of the court, at page 547:

> The right of a riparian proprietor of land bordering upon a running stream to the benefit to be derived from the flow of its waters as a natural incident to, or one of the elements of, his estate, and that it can not be lawfully diverted against his consent, is not denied, nor does the controversy relate to the just and reasonable use as between riparian proprietors.

It will also be noticed that in that case the force and effect of the following provision in the act of

March 3, 1877 (19 Stat., 377), was not raised or considered, viz:

> The water of all lakes, rivers, and other sources of water supply upon the public lands, not navigable, shall remain and be held free for the appropriation and use of the public for irrigation, mining, and manufacturing purposes, subject to existing rights.

The case was heard at the October term, 1889, of this court. At that time the reclamation and cultivation of the arid lands in the United States was not regarded as of very great importance, nor was the necessity for a departure from the common-law doctrine of riparian rights appreciated. Since the case was decided Congress has passed the Carey Act, and the so-called reclamation act heretofore referred to, and we have had from this court decisions in *Fallbrook* v. *Bradley* (164 U. S., 112), *Guiterras* v. *Albuquerque Land and Irrig. Co.* (188 U. S., 545), *Clark* v. *Nash* (198 U. S., 361), and *U. S.* v. *Rio Grande Dam & Irr. Co.* (174 U. S., 690).

The application to interstate streams situated as is the Arkansas River of the doctrine of appropriation, etc., will not destroy the stream in the lower State, but will leave or return sufficient water to the bed thereof in such State to meet the domestic requirements of the owners of riparian lands.

Even in the arid region domestic purposes, which include the watering of stock, etc., is the highest use to which water can be put (1285, 1387). Any system, therefore, which would tend to destroy or diminish

the flow thereof below that which is necessary for domestic purposes would be illegal.

In the opinion of the court upon the demurrer in this case it was stated, among other things (44), that "proof should be made as to whether Colorado is herself actually threatening to wholly exhaust the flow of the Arkansas River in Kansas." The evidence of defendant Colorado tends to show that it is neither using nor threatening to use for irrigation purposes any of the waters of said stream (1826). Complainant's evidence tends to show, however, that the citizens of Colorado, individuals and corporations, are using all the waters of said stream that they possibly can divert and use (491–505, 529–534, 1373–1377; see also intervenor's Exhibit No. 7).

Witnesses for the defendants and for the intervenor testified, in effect, that if irrigation in the upper State were confined to lands within the watershed of the stream it would be impossible wholly to exhaust the flow thereof in the lower State, and that there would always be enough water in the bed of the stream in said lower State for domestic purposes, etc. The evidence on this point will be found in the printed transcript of the record at pages 632, 672, 673, 720, 835, 837, 855, 858, 870, 890, 894, 897, 913, 915, 918, 927, 928, 940, 941, 952, 957, 1028, 1066, 1078, 1084, 1117, 1130, 1186, 1187, 1200, 1217, 1292, 1330, 1331, 1380, 1381, 1382, 1385.

(2) *The erection of reservoirs to impound the flood waters, which is necessary in order to carry out the policy of the Government as indicated in the so-called "Reclamation Act," will have the effect of maintaining and equalizing the flow of the river in Kansas.*

In its opinion upon the demurrer the court further stated that proof should be submitted in regard to "the possibilities of the maintenance of a sustained flow through the control of flood waters" (44).

Upon this point Mr. T. C. Henry, a witness for Colorado, says (716–717):

> I think it is a practicable scheme to erect reservoirs above the Colorado line to catch the flood and other waters that would keep up the normal average flow at the State line to 600 feet and still give the ditches in Colorado the water they are entitled to.

A. L. Fellows (1064) says, in effect, that the erection of reservoirs in Colorado to store flood waters in the drainage basin of the Arkansas River would be very advantageous. At 1065 he says, in effect, that the storage of the flood waters would equalize the flow of the river and that the conditions in the Arkansas Valley might be improved by means of storage.

W. M. Wiley (1441) says that irrigation and the storage of water in Colorado along the Arkansas River has steadily increased the flow of the river in Kansas by reason of the return of seepage waters.

J. J. Hagerman (1151–1152) says:

> If by proper storage reservoirs the water were held back in Colorado, stored up in the mountains, then it could be used in Colorado and a very large share of it would go down to Kansas, so that irrigating could be done there on a considerable scale. You can not store water in a flat country. It has to be stored in the foothills and places where nature has made reservoir sites that could be improved. If that water were allowed to run to waste, it would go right away over Colorado and down past Kansas and no one would use it. Let me cite an instance: When we were building the big McMillan reservoir in the lower Pecos Valley some people who owned an irrigation enterprise at Barstow, Tex., informed us that they would not allow us to store water in the reservoir because the water belonged to them; that they had the right to it and that they were an older concern than we were. We told them that the biggest floods in the Pecos Valley came in the fall when they could not use the water anyway and it was running to waste and they were short of water in the dry season, and that if we stored water in very large quantities in these big reservoirs and used it in the dry season when there were no rains a large share of it would go back to the river and there would be a good deal more water in the Pecos River at the time of year when they needed it the most than if the reservoirs were never built. Now, that proved to be a fact. I know that to be a fact. The president of that company, Mr. Barstow—I know

> him very well—has told me often that our reservoir system there was a godsend to them because they got water in the dry season when they needed it.

B. S. Rodey (1160) says that the construction of reservoirs in an upstream State and the use of waters in that State at times when there is an excess of water would augment the flow of the stream in the downstream State at a time when the water may be low.

Joseph M. Dixon (1202) says:

> The building of reservoirs tends to make the flow more continuous. I know of one stream personally in the Bitter Root country where they have a reservoir at the head of it. I think it usually went dry in the early part of August. The building of the reservoir lets some of the water down practically in September now.

Louis G. Carpenter (1838) says that every reservoir tends to control the flood waters and to maintain a substantial flow in the river below.

It is submitted that the Government has a vital interest in this controversy; that the reclamation and cultivation of the arid lands of the United States is ndispensable to the growth and future prosperity of the nation; that the public arid lands can not be reclaimed if the main contention of either of the two States should be sustained; that the questions involved, in their nature and because they are of first impression, are of immense importance; and that because of the interests of the arid portions of the

United States as well as of the country at large, as distinguished from the interests of the two contending States, the Government, representing those larger interests, should be protected in any decree which the court shall enter herein.

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Appendix A.

CAREY ACT, AUGUST 18, 1894 (28 STAT., 422).

"That to aid the public land States in the reclamation of the desert lands therein, and the settlement, cultivation, and sale thereof in small tracts to actual settlers, the Secretary of the Interior, with the approval of the President, be, and hereby is, authorized and empowered, upon proper application of the State to contract and agree, from time to time, with each of the States in which there may be situated desert lands, as defined by the act entitled 'An act to provide for the sale of desert land in certain States and Territories,' approved March third, eighteen hundred and seventy-seven, and the act amendatory thereof, approved March third, eighteen hundred and ninety-one, binding the United States to donate, grant, and patent to the State free of costs for survey or price such desert lands, not exceeding one million acres in each State, as the State may cause to be irrigated, reclaimed, occupied, and not less than twenty acres of each one hundred and sixty acre tract cultivated by actual settlers, within ten years next after the passage of this act, as thoroughly as is required of citizens who may enter under the said desert-land law.

"Before the application of any State is allowed or any contract or agreement is executed or any segregation of any of the lands from the public domain is ordered by the Secretary of the Interior, the State shall file a map of the said land proposed to be irrigated, which shall exhibit a plan showing the mode of the contemplated irrigation and which plan shall be sufficient to thoroughly irrigate and reclaim said land and prepare it to raise ordinary agricultural crops, and shall also show the source of the water to be used for irrigation and reclamation, and the Secretary of the Interior may make necessary regulations for the reservation of the lands applied for by the State, to date from the date of the filing of the map

and plan of irrigation, but such reservation shall be of no force whatever if such map and plan of irrigation shall not be approved.

"That any State contracting under this section is hereby authorized to make all necessary contracts to cause the said lands to be reclaimed, and to induce their settlement and cultivation in accordance with and subject to the provisions of this section; but the State shall not be authorized to lease any of said lands or to use or dispose of the same in any way whatever, except to secure their reclamation, cultivation, and settlement.

"As fast as any State may furnish satisfactory proof, according to such rules and regulations as may be prescribed by the Secretary of the Interior, that any of said lands are irrigated, reclaimed, and occupied by actual settlers, patents shall be issued to the State or its assigns for said lands so reclaimed and settled: *Provided*, That said States shall not sell or dispose of more than one hundred and sixty acres of said lands to any one person, and any surplus of money derived by any State from the sale of said lands in excess of the cost of their reclamation shall be held as a trust fund for and be applied to the reclamation of other desert lands in such State. * * *

The above act was amended June 11, 1896 (29 Stat., 434), as follows:

"That under any law heretofore or hereafter enacted by any State, providing for the reclamation of arid lands, in pursuance and acceptance of the terms of the grant made in section four of an act entitled 'An act making appropriations for the sundry civil expenses of the Government for the fiscal year ending June thirtieth, eighteen hundred and ninety-five,' approved August eighteenth, eighteen hundred and ninety-four, a lien or liens is hereby authorized to be created by the State to which such lands are granted and by no other authority whatever, and when created shall be valid on and against the separate legal subdivisions of land reclaimed for the actual cost and necessary expenses of reclamation and reasonable interest thereon from the date of reclamation until disposed of to actual settlers; and when an ample supply of water is actually furnished in a substantial ditch or

canal, or by artesian wells or reservoirs, to reclaim a particular tract or tracts of such lands, then patents shall issue for the same to such State without regard to settlement or cultivation: *Provided*, That in no event, in no contingency, and under no circumstances shall the United States be in any manner directly or indirectly liable for any amount of any such lien or liability, in whole or in part."

It was further amended March 3, 1901 (31 Stat., 1188), as follows:

"That section four of the act of August eighteenth, eighteen hundred and ninety-four, entitled 'An act making appropriations for sundry civil expenses of the Government for the fiscal year ending June thirtieth, eighteen hundred and ninety-five, and for other purposes,' is hereby amended so that the ten years' period within which any State shall cause the lands applied for under said act to be irrigated and reclaimed, as provided in said section as amended by the act of June eleventh, eighteen hundred and ninety-six, shall begin to run from the date of approval by the Secretary of the Interior of the State's application for the segregation of such lands; and if the State fails within said ten years to cause the whole or any part of the lands so segregated to be so irrigated and reclaimed, the Secretary of the Interior may, in his discretion, continue said segregation for a period of not exceeding five years, or may, in his discretion, restore such lands to the public domain."

Appendix B.

RECLAMATION ACT (32 Stats., 388).

An Act Appropriating the receipts from the sale and disposal of public lands in certain States and Territories to the construction of irrigation works for the reclamation of arid lands.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That all moneys received from the sale and disposal of public lands in Arizona, California, Colorado, Idaho, Kansas, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oklahoma, Oregon, South Dakota, Utah, Washington, and Wyoming, beginning with the fiscal year ending June thirtieth, nineteen hundred and one, including the surplus of fees and commissions in excess of allowances to registers and receivers, and excepting the five per centum of the proceeds of the sales of public lands in the above States set aside by law for educational and other purposes, shall be, and the same are hereby, reserved, set aside, and appropriated as a special fund in the Treasury, to be known as the "reclamation fund," to be used in the examination and survey for and the construction and maintenance of irrigation works for the storage, diversion, and development of waters for the reclamation of arid and semiarid lands in the said States and Territories, and for the payment of all other expenditures provided for in this act: *Provided*, That in case the receipts from the sale and disposal of public lands other than those realized from the sale and disposal of lands referred to in this section are insufficient to meet the requirements for the support of agricultural colleges in the several States and Territories, under the act of August thirtieth, eighteen hundred and ninety, entitled "An act to apply a portion of the proceeds of the public lands to the more complete endowment and support of the colleges for the benefit of agriculture and the mechanic arts, established under the provisions of an act of Congress approved July second, eighteen hundred and sixty-two," the deficiency, if

any, in the sum necessary for the support of the said colleges shall be provided for from any moneys in the Treasury not otherwise appropriated.

SEC. 2. That the Secretary of the Interior is hereby authorized and directed to make examinations and surveys for, and to locate and construct, as herein provided, irrigation works for the storage, diversion, and development of waters, including artesian wells, and to report to Congress at the beginning of each regular session as to the results of such examinations and surveys, giving estimates of cost of all contemplated works, the quantity and location of the lands which can be irrigated therefrom, and all facts relative to the practicability of each irrigation project; also the cost of works in process of construction as well as of those which have been completed.

SEC. 3. That the Secretary of the Interior shall, before giving the public notice provided for in section four of this act, withdraw from public entry the lands required for any irrigation works contemplated under the provisions of this act, and shall restore to public entry any of the lands so withdrawn when, in his judgment, such lands are not required for the purposes of this act; and the Secretary of the Interior is hereby authorized, at or immediately prior to the time of beginning the surveys for any contemplated irrigation works, to withdraw from entry, except under the homestead laws, any public lands believed to be susceptible of irrigation from said works: *Provided*, That all lands entered and entries made under the homestead laws within areas so withdrawn during such withdrawal shall be subject to all the provisions, limitations, charges, terms, and conditions of this act; that said surveys shall be prosecuted diligently to completion, and upon the completion thereof, and of the necessary maps, plans, and estimates of cost, the Secretary of the Interior shall determine whether or not said project is practicable and advisable, and if determined to be impracticable or unadvisable he shall thereupon restore said lands to entry; that public lands which it is proposed to irrigate by means of any contemplated works shall be subject to entry only under the provisions of the homestead laws in tracts of not less than forty nor more than one hundred and sixty acres, and shall be subject to the limitations,

charges, terms, and conditions herein provided: *Provided*, That the commutation provisions of the homestead laws shall not apply to entries made under this act.

SEC. 4. That upon the determination by the Secretary of the Interior that any irrigation project is practicable, he may cause to be let contracts for the construction of the same, in such portions or sections as it may be practicable to construct and complete as parts of the whole project, providing the necessary funds for such portions or sections are available in the reclamation fund, and thereupon he shall give public notice of the lands irrigable under such project and limit of area per entry, which limit shall represent the acreage which, in the opinion of the Secretary, may be reasonably required for the support of a family upon the lands in question; also of the charges which shall be made per acre upon the said entries, and upon lands in private ownership which may be irrigated by the waters of the said irrigation project, and the number of annual installments, not exceeding ten, in which such charges shall be paid and the time when such payments shall commence. The said charges shall be determined with a view of returning to the reclamation fund the estimated cost of construction of the project and shall be apportioned equitably: *Provided*, That in all construction work eight hours shall constitute a day's work, and no Mongolian labor shall be employed thereon.

SEC. 5. That the entryman upon lands to be irrigated by such works shall, in addition to compliance with the homestead laws, reclaim at least one-half of the total irrigable area of his entry for agricultural purposes, and before receiving patent for the lands covered by his entry shall pay to the Government the charges apportioned against such tract, as provided in section four. No right to the use of water for land in private ownership shall be sold for a tract exceeding one hundred and sixty acres to any one landowner, and no such sale shall be made to any landowner unless he be an actual bona fide resident on such land, or occupant thereof residing in the neighborhood of said land, and no such right shall permanently attach until all payments therefor are made. The annual installments shall be paid to the receiver of the local land office of the district in which the land is situated, and a failure to make any two payments when due shall

render the entry subject to cancellation, with the forfeiture of all rights under this act, as well as of any moneys already paid thereon. All moneys received from the above sources shall be paid into the reclamation fund. Registers and receivers shall be allowed the usual commissions on all moneys paid for lands entered under this act.

SEC. 6. That the Secretary of the Interior is hereby authorized and directed to use the reclamation fund for the operation and maintenance of all reservoirs and irrigation works constructed under the provisions of this act: *Provided*, That when the payments required by this act are made for the major portion of the lands irrigated from the waters of any of the works herein provided for, then the management and operation of such irrigation works shall pass to the owners of the lands irrigated thereby, to be maintained at their expense under such form of organization and under such rules and regulations as may be acceptable to the Secretary of the Interior: *Provided*, That the title to and the management and operation of the reservoirs and the works necessary for their protection and operation shall remain in the Government until otherwise provided by Congress.

SEC. 7. That where in carrying out the provisions of this act it becomes necessary to acquire any rights or property the Secretary of the Interior is hereby authorized to acquire the same for the United States by purchase or by condemnation under judicial process, and to pay from the reclamation fund the sums which may be needed for that purpose; and it shall be the duty of the Attorney-General of the United States, upon every application of the Secretary of the Interior under this act, to cause proceedings to be commenced for condemnation within thirty days from the receipt of the application at the Department of Justice.

SEC. 8. That nothing in this act shall be construed as affecting or intended to affect or to in any way interfere with the laws of any State or Territory relating to the control, appropriation, use, or distribution of water used in irrigation, or any vested right acquired thereunder; and the Secretary of the Interior, in carrying out the provisions of this act, shall proceed in conformity with such laws, and nothing herein shall in any way affect any right of any State or of the Federal Government, or of any landowner, appropriator, or user

of water in, to, or from any interstate stream or the waters thereof: *Provided*, That the right to the use of water acquired under the provisions of this act shall be appurtenant to the land irrigated, and beneficial use shall be the basis, the measure, and the limit of the right.

SEC. 9. That it is hereby declared to be the duty of the Secretary of the Interior in carrying out the provisions of this act, so far as the same may be practicable and subject to the existence of feasible irrigation projects, to expend the major portion of the funds arising from the sale of public lands within each State and Territory hereinbefore named for the benefit of arid and semiarid lands within the limits of such State or Territory: *Provided*, That the Secretary may temporarily use such portion of said funds for the benefit of arid or semiarid lands in any particular State or Territory hereinbefore named as he may deem advisable, but when so used the excess shall be restored to the fund as soon as practicable, to the end that ultimately, and in any event within each ten-year period after the passage of this act, the expenditures for the benefit of the said States and Territories shall be equalized according to the proportions and subject to the conditions as to practicability and feasibility aforesaid.

SEC. 10. That the Secretary of the Interior is hereby authorized to perform any and all acts and to make such rules and regulations as may be necessary and proper for the purpose of carrying the provisions of this act into full force and effect.

Approved, June 17, 1902.

Appendix C.

SLICHTER'S REPORT.

"The investigation of the underflow of Arkansas River, described in this paper, was made during the summer of 1904. The field party was under the general supervision of the writer. Mr. Henry C. Wolff had charge of the measurements of the rate of movement of the ground waters. He also made careful determinations of the fluctuation of the position of the water plane, and the success of the field work was largely due to his skill and hard work. Mr. Ray Owen had charge of level and plane-table work, and made a contour map of the water plane.

"A few of the principal conclusions may be summarized as follows:

"1. The underflow of Arkansas River moves at an average rate of 8 feet per twenty-four hours in the general direction of the valley.

"2. The water plane slopes to the east at the rate of 7.5 feet per mile, and toward the river at the rate of 2 to 3 feet per mile.

"3. The moving ground water extends several miles north from the river valley. No north or south limit was found.

"4. The rate of movement is very uniform.

"5. The underflow has its origin in the rainfall on the sand hills south of the river and on the bottom lands and plains north of the river.

"6. The sand hills constitute an essential part of the catchment area.

"7. The influence of the floods in the river upon the ground-water level does not extend one-half mile north or south of the channel.

"8. A heavy rain contributes more water to the underflow than a flood.

"9. On the sandy bottom lands 60 per cent of an ordinary rain reaches the water plane as a permanent contribution.

"10. The amount of dissolved solids in the underflow grows less with the depth and with the distance from the river channel.

"11. There is no appreciable run-off in the vicinity of Garden, Kans. Practically all of the drainage is underground through the thick deposits of gravels.

"12. Carefully constructed wells in Arkansas Valley are capable of yielding very large amounts of water. Each square foot of percolating surface of the well strainers can be relied upon to yield more than 0.25 gallon of water per minute under 1 foot head.

"13. There is no indication of a decrease in the underflow at Garden in the last five years. The city well showed the same specific capacity in 1904 that it had in 1899.

"14. Private pumping plants in the bottom lands will be profitable for irrigation if proper kind of power be used. There should be a large field of usefulness for suction gas-producer power plants of from 20 to 100 horsepower, with Colorado hard coal or coke as fuel. Kansas crude oil in gas generators should prove profitable for use in the smaller plants. The present cost of pumping with gasoline for fuel is not encouraging."

In Chapter IV, pages 51, 54, entitled "Origin and Extent of the Underflow," omitting the illustrations, he states as follows:

"The investigations which have been explained in the preceding pages of this report indicate that the water of the Arkansas underflow has its main source in the rainfall upon the sand hills south of the river and upon the bottom lands and uplands north of the river.

"The average annual rainfall in the vicinity of Garden is about 20 inches. A very large portion of this passes into the level and porous soil, so that the actual contribution to the underflow must be considerable. As previously stated in this paper there is a ground-water district along the river that remains lower than the river, whether the same be flowing or not, in which region the rise in the ground water after a rain is more than can be accounted for by the localized precipitation. This fact indicates not only that the underground drainage at this point is contributed to by rainfall on distant

catchment areas, but that the underflow constitutes a separate drainage system which is more than sufficient to take care of the rainfall. Determinations made in the sandy flats south of the river at Deerfield (see Chap. II) show that the rise in the water plane, observed after a rain storm, amounts to as much as 60 per cent of the water that fell. This fact verifies what is quite obvious to a careful observer, that there is no run-off from the lands adjacent to Arkansas River in the region under discussion.

"The total depths of the deposits of sand and gravels at Garden is not known very exactly. A deep well was sunk at Garden in 1888, which, according to a partial log printed in the local newspaper, showed that rock was reached at a depth of 311 feet. Every indication drawn from the behavior of the ground water shows that the gravels must extend to a considerable depth, so that it is safe to assume that the well log just referred to gives a correct notion of the depth to rock. However, as one approaches the western boundary of Kansas, bed rock comes near the surface, which fact, even if no other evidence were at hand, would show that no portion of the ground water could originate in Colorado. The former popular belief in a Colorado source of the ground water has practically disappeared, although a few settlers still adhere to it. During the summer of 1904 one resident of Finney County informed the writer that the water in his well was invariably roily after a rain storm during the preceding night in Colorado. This corresponds to nearly passenger-train speed for the flow of ground water. The story may be regarded as about the sole surviving ghost of the numerous extravagant beliefs which were formerly current among the settlers.

"The region near Garden, Kans., is peculiarly the area properly called the High Plains. The land is level and completely covered in its natural condition with a short, compact sod of buffalo grass. Johnson and other writers on this region have remarked the complete lack of run-off from this portion of the plains area. The precipitation falls mostly during the summer months and is sufficient in amount to maintain a luxuriant sod, which not only protects the soil against erosion, but prevents, by the obstruction offered by the grass, the escape of the water in flowing torrents. In consequence the rainfall is completely taken care of by ab-

sorption into the ground and by evaporation and use by the vegetation. Eastward from the High Plains region rainfall is greater, and the sod is not able to prevent the formation of rills and eroded channels, so that much of the water runs off into surface streams. Westward from the High Plains district as Colorado is approached the rainfall decreases, and in consequence vegetation becomes so scant that it is not able to protect the surface of the ground from erosion even from a diminished rainfall. Hence it is that both to the east and west of the High Plains there is a marked run-off, but in the plains district proper the rains are disposed of by absorption.

"The above facts are well shown by the results previously discussed in this paper. The summer of 1904 was one of unusually ample rain fall in the plains, and many floods came down the river. The river was carefully watched by the field party and its elevation noted. Figs. 16 and 17 show the elevation of the river at Sherlock and Deerfield bridges, respectively, compared with the rainfall at Garden. A similar diagram for camp 1, near Garden, is given in fig. 10. A study of these diagrams shows practically no influence of the rainfall upon the stream. Many of these rains extended into Colorado, where they were the cause of floods that showed themselves at the camps in Kansas many hours after the rain. Thus we have ample evidence of no run-off from the country between Garden and Deerfield, and at the same time have proof of a considerable run-off from the watershed toward the western limit of Kansas and in Colorado.

"The few instances in which small surface streams are formed near the Colorado line—like the plains streams known as Bear Creek and White Woman Creek—are no exception to the statement above that there is no run-off into the Arkansas in the High Plains district, for these streams entirely disappear as surface streams before the Arkansas is reached. Their waters, less the evaporation, are ultimately joined to the underflow. The situation may be summarized in the following words: The underground drainage in this region is so enormous, and the water passes through the gravel so freely, that there is no surplus water left to form surface streams or to form a perennial supply for Arkansas River. If the gravels of the plains near Garden were less deep, it is entirely

conceivable that the Arkansas River would be a perennial spring-fed stream at this point.

"The large contribution to the underflow, which is made by the rainfall upon the sand hills south of the river, is clearly demonstrated by the course of the contours in fig. 5. In this diagram the soft water from the south side of the river can be observed to be pressing the hard water of the first bottoms northward toward the left side of the river valley.

* * * * *

"A noteworthy feature of the underflow is the lack of any natural north or south limitation to the easterly moving stream.

"There are important changes from place to place in the north and south slope of the water plane, but none are of sufficient consequence to materially modify the dominant influence of the easterly gradient of 7 to 8 feet to the mile. The velocities found at the edge of the sand hills to the south of the river, and at a distance as high as 9 miles from the channel of the river, are about the same as those found near the bed of the river in similar material. There is nothing surprising in this except that the stratification of the sand and gravel on the High Plains is such that there is no natural north or south limitation to the eastward-moving ground waters."

O

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No. 3, Original.

IN THE SUPREME COURT OF THE UNITED STATES.

OCTOBER TERM, 1906.

STATE OF KANSAS, COMPLAINANT,

v.

STATE OF COLORADO ET AL., AND THE UNITED STATES, INTERVENOR.

REDUCED ABSTRACT.

FILED AS APPENDIX TO BRIEF OF INTERVENOR.

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In the Supreme Court of the United States.

OCTOBER TERM, 1906.

STATE OF KANSAS, COMPLAINANT,
v.
STATE OF COLORADO ET AL., DEFENDANTS, AND THE UNITED STATES, INTERVENOR. } No. 3, Original.

REDUCED ABSTRACT.

I.

HISTORY OF THE CASE.

May 13, 1901, counsel for the State of Kansas submitted a motion for leave to file a bill of complaint against the State of Colorado. The same day leave was granted the attorney-general of Colorado to file objections thereto (1–5 [a]). May 20, 1901, motion to file bill was granted and a subpœna ordered to be issued and served, returnable Monday, October 14, 1901. On the same day the bill was filed (6). October 15, 1901, by leave of court, demurrer of Colorado filed. October 21, 1901, leave granted defendant to file brief on or before December 2, 1901, to complainant to file brief in reply on or before February 3, 1902, and the cause was assigned for argument February 24, 1902 (25). February 24, 1902, oral argument begun, and concluded February 25, 1902. Same day leave granted complainant to file additional brief within seven days, and defendant to file a reply brief thereto (28). April 7, 1902, demurrer overruled without prejudice and opinion rendered (185 U. S., 125) (29). November 3, 1902, by leave of court, answer of defendant filed. June 1, 1903, leave requested by and granted to complainant to file a new and amended bill, to make additional defendants and for subpœna to such other defendants filed (61, 62). August 18, 1903, subpœna for additional defendants issued (76). October 6, 1903, subpœna with proof of service filed (76–78). October 14, 1903, separate answers of the State of Colorado and of The Graham Ditch Company to

[a] Unless otherwise indicated, page references are to the printed record.

amended bill of complaint filed (79–123). November 2, 1903, separate answers of The Arkansas Valley Sugar Beet and Irrigated Land Company and The Fort Lyon Canal Company filed (123). Same day, joint and several answers of The Rocky Ford Canal Reservoir, Land, Loan, and Trust Company, The Catlin Consolidated Canal Company, The Oxford Farmers' Ditch Company, and The Laguna (lake) Canal Company to amended bill filed (124–189). November 11, 1903, answer of Colorado Fuel and Iron Company filed (190–208). January 12, 1904, order entered requiring complainant to plead to answers filed on or before the first Monday in March, 1904 (208, 209). March 7, 1904, replications of the State of Kansas to all the answers filed (209–228). March 14, 1904, motion of Attorney-General Knox for leave to intervene on behalf of the United States filed (229–230). Same day motion to dismiss filed on behalf of The Arkansas Valley Sugar Beet and Irrigated Land Company, The Graham Ditch Company, The Colorado Fuel and Iron Company, The Fort Lyon Canal Company, The Rocky Ford Canal Reservoir, Land, Loan, and Trust Company, The Catlin Consolidated Canal Company, The Oxford Farmers' Ditch Company, and The Lake Canal Company (231–234). March 21, 1904, petition of intervention on behalf of the United States filed (234–240). April 29, 1904, answer of State of Kansas to petition of intervention filed (242). May 2, 1904, motion to dismiss submitted on printed arguments (242, 243). May 16, 1904, consideration of motion to dismiss postponed until hearing of cause on merits. Same day motion of all parties for appointment of special commissioner to take the testimony in the case and report same filed (243). Same day order entered appointing Granville A. Richardson special commissioner (244, 245). November 29, 1904, the attorney-general for the State of Kansas, the attorney-general for the State of Colorado, and the Assistant Attorney-General of the United States joined in a request and moved the court for an order for permission to prepare an abstract of the evidence and for leave to print and file the abstract with the clerk in lieu of printing the original evidence; and that the special commissioner file the original evidence without printing the same (245). Same day order entered as requested (246).

September 26, 1905, motion filed by attorneys for the State of Kansas for an order fixing time for final argument and specifying time within which briefs for respective parties to be filed (248, 249). October 10, 1905, above motion submitted to court (248). October 16, 1905, order entered by court assigning case for argument on Tuesday, October 9, 1906, and requiring counsel for Kansas to file their brief within three months from the date of said order, counsel for the State of Colorado et al. to file their briefs within six months from the date of said order, and counsel for the United States to file their briefs within nine months from the date of said order (249). April 16, 1906, order entered extending time until September 1, 1906, for intervenor to prepare and file brief.

The taking of evidence was begun August 15, 1904, at Wichita, Kans., and concluded June 16, 1905, at Topeka, Kans. (250–2286). As transcribed from the stenographer's notes, the evidence covers nearly 8,600 typewritten pages of ordinary brief size. The com-

plainant's evidence in chief, as transcribed, covers about 2,025 typewritten pages and in rebuttal about 1,520 pages (250–616, 1858–2285); that of defendant Colorado about 3,200 typewritten pages (617–977, 979–1022, 1454–1855); that of defendant The Colorado Fuel and Iron Company about 36 typewritten pages (2456–2492); that of defendant The Graham Ditch Company about 3 typewritten pages (977–979); that of defendant The Arkansas Valley Sugar Beet and Irrigated Land Company about 27 typewritten pages (1427–1454); and that of the intervenor about 1,650 typewritten pages (1022–1427). Testimony was given by 345 persons, and of these 147 were called by and testified for complainant, 67 in chief and 80 in rebuttal; 157 were called by and testified for defendants, of whom 154 were for Colorado, 1 for The Colorado Fuel and Iron Company, 1 for The Graham Ditch Company, and 1 for The Arkansas Valley Sugar Beet and Irrigated Land Company; and 48 were called by and testified for the intervenor.

II.

THE PARTIES.

(1) COMPLAINANT.

The complainant, the State of Kansas, was admitted into the Union by the act of January 29, 1861 (12 Stat., 126), and was included within the boundaries and constituted the major part of the Territory of Kansas, created by the act of May 30, 1854 (10 Stat., 277, 283, etc.).

(2) DEFENDANTS.

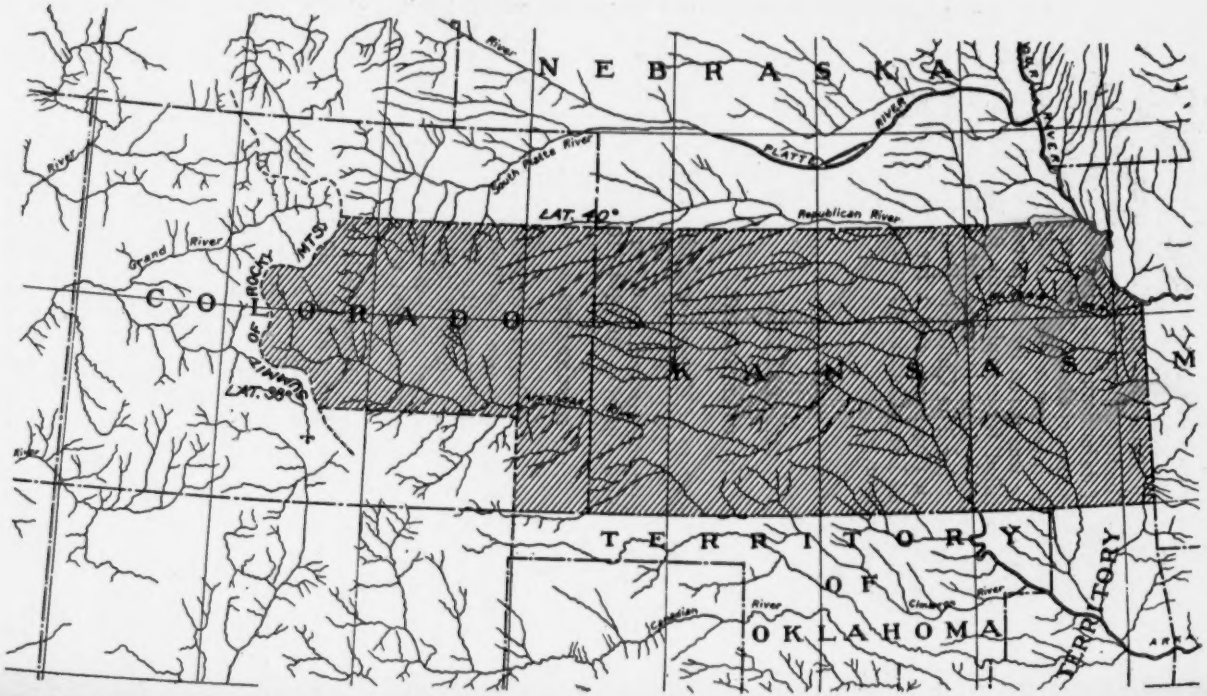
The defendant, the State of Colorado, was admitted into the Union August 1, 1876. (See President's proclamation, 19 Stat., 665.) With its present boundaries it constituted the Territory of Colorado, created by the act of February 28, 1861 (12 Stat., 172). A large portion of said Territory and State which lies within the drainage area of the Arkansas River was embraced within the boundaries of the said Territory of Kansas.

The map appearing at page 4 shows the boundaries of the Territory of Kansas as created by the act of May 30, 1854.

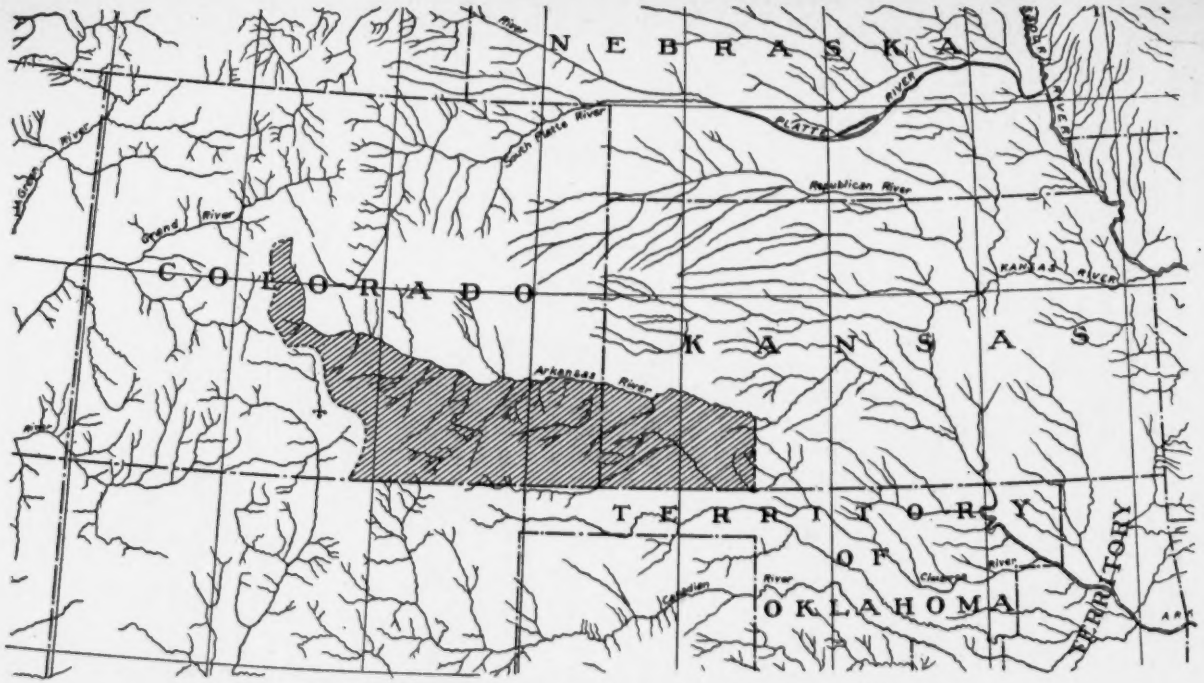
All of the said Territory constituted a part of the Territory of Missouri, created by the act of June 4, 1812 (2 Stat., 743).

All of the State of Kansas and all of that part of Colorado which formerly was a part of the Territory of Kansas, as shown by the above map, was, as claimed by the United States, acquired from France by the treaty of April 30, 1803 (8 Stat., 200).

It seems, however, that subsequent to the aforesaid treaty Spain's claim to a large extent of territory west of the Mississippi River, not shown herein, included a small area of the present State of Kansas in the southwestern part, immediately south of the south bank of the Arkansas River, and within its drainage basin, and also a large area of the present State of Colorado within said basin. This claim in Colorado and Kansas is shown by the map which appears at page 5.



(a) Map of Territory of Kansas as created by act of May 30, 1854.



(b) Map of portions of States of Kansas and Colorado claimed by Spain after the Louisiana Purchase.

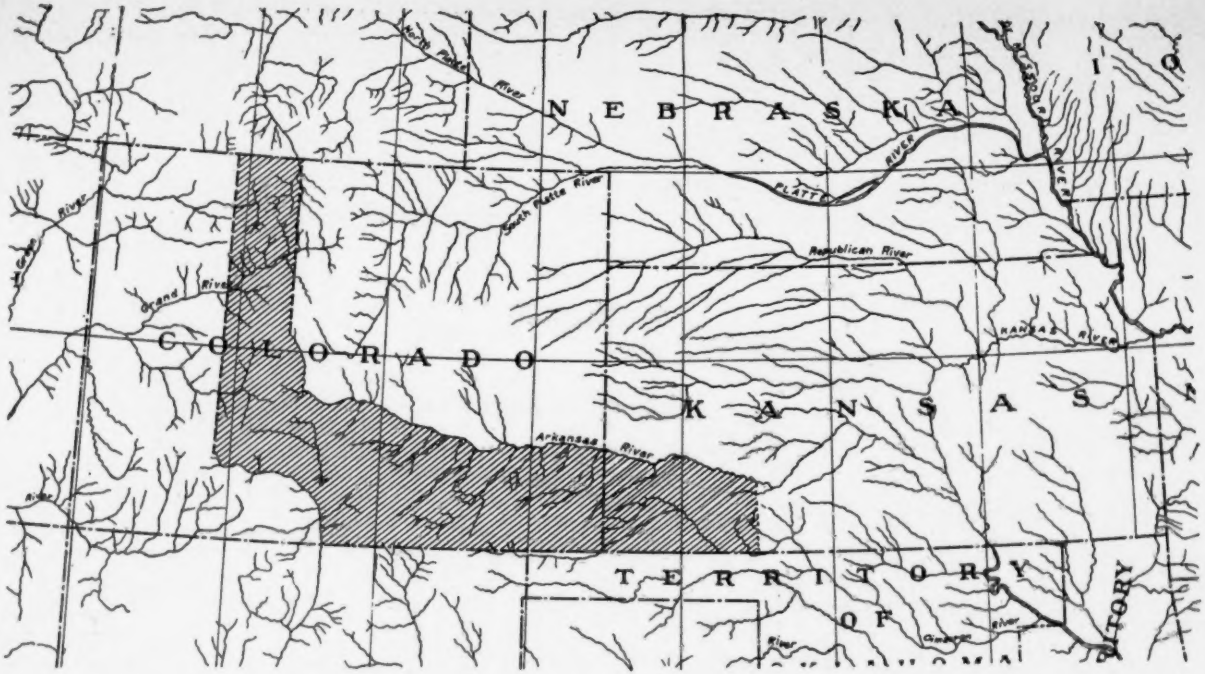
For the purpose of securing an adjustment of the boundary line between the United States and Spain by the treaty of February 22, 1819, ratified February 19, 1821 (8 Stat., 252), it would seem that the above claim of Spain was conceded to her by this country. By the treaty between the United States and Mexico of January 28, 1828, ratified April 5, 1832 (8 Stat., 372), it would appear that the area last above referred to was conceded by the United States to belong to Mexico. This area, together with considerable more which this country claimed it had purchased from France, was subsequently claimed by the Republic of Texas. This claim of Texas, so far as it affects Kansas and Colorado, is shown by the map appearing at page 7.

By the terms of the treaty of April 25, 1838, between the United States and the Republic of Texas, ratified October 13, 1838 (8 Stat., 511), provision was made for the running of the boundary line between the two Republics. Before this provision could be carried out Texas was admitted into the Union by the joint resolution of Congress of December 29, 1845 (9 Stat., 108). By act of Congress of September 9, 1850 (9 Stat., 446) the United States proposed to the State of Texas that she cede to the former, for the considerations in the act expressed, all the territory in dispute between the parties, which proposal Texas accepted by an act of her legislature approved November 25, 1850. (See *United States* v. *Texas*, 143 U. S., 621, 635.) That part of Colorado west of the summit of the Rocky Mountains, and as shown by the map, which appears at page 8, was acquired from Mexico by the treaty of February 2, 1848, proclaimed July 4, 1848 (9 Stat., 922).

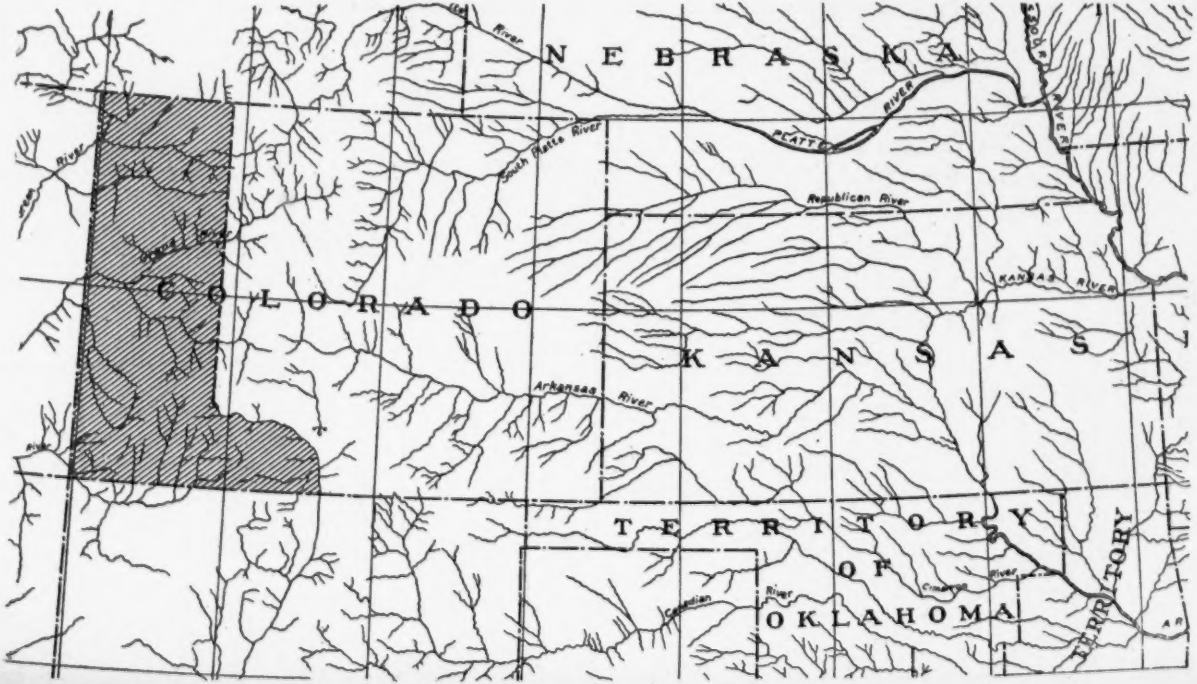
The other defendants are corporations organized and existing under and by virtue of the laws of Colorado and residing and doing business within said State. All of them are engaged in the irrigation of lands within said State, or furnishing water for such purpose, except the Colorado Fuel and Iron Company, which, according to the testimony of its secretary, D. C. Beaman (729), is "engaged in the mining of coal and the manufacture of coke and steel and iron products." All of the defendants, except the State of Colorado, have appropriated and now use the waters of the Arkansas River in Colorado.

(3) INTERVENOR.

The intervenor, the United States, has an interest which will be affected by the final decree, no matter what its terms. It is not a party to the suit in a technical sense. It is neither complainant nor defendant. It has "no right to interfere in the pleadings, or evidence or admissions of the states, or either of them." It has the "right to adduce evidence and be heard, before the judgment is given." It is not liable to a decree against it, nor entitled to a decree in its favor. (See *Florida* v. *Georgia*, 17 How., 478, 495.)



(c) Map of portions of States of Kansas and Colorado obtained from Texas by act of September 9, 1850.



(d) Map of portion of other part of the State of Colorado acquired from Mexico.

III.

THE PLEADINGS.

(1) AMENDED BILL OF COMPLAINT.

The material allegations as set forth in the amended bill of complaint are substantially as follows:

That the Arkansas River rises in the Rocky Mountains, in the State of Colorado, and flows easterly for about 280 miles therein through the counties of Lake, Chaffee, Fremont, Pueblo, Otero, Bent, and Prowers; thence flows into the State of Kansas and through the counties of Hamilton, Kearney, Finney, Gray, Ford, Edwards, Pawnee, Barton, Rice, Sedgwick, Sumner, and Cowley (63)—a distance of about 310 miles (64); thence into and through Oklahoma, Indian Territory, and Arkansas (63). That all the tributaries of the river in Colorado have their rise in said State. That the drainage area of said river in Colorado is about 22,000 square miles, all of which is east of the summit of the Rocky Mountains, and a large portion of it in the mountains, where the fall of snow in the winter is great. That this snow melts during the spring and summer and the waters therefrom in great volume flow into the river from the early spring until August each year. That the river after leaving the mountains is a navigable stream under the laws and departmental rules and regulations of the United States. That the lands bordering on the river and its tributaries in Colorado are arid and barren (63). That the mean average flow of the water at the State line, if not diverted in Colorado, would be upward of 2,000 cubic feet per second of time (63). That its average flow at any point in Colorado does not exceed 700 second-feet, and of its tributaries in Colorado does not exceed 700 second-feet (71). That its tributaries in Kansas are few in number and do not, except near the Oklahoma line, furnish water sufficient to furnish a continuous stream in its bed (63). That in Kansas it flows at an elevation of 3,350 feet when it enters the State and about 1,000 feet at the Oklahoma line, with an average fall of 7.3 feet per mile through a broad valley of about 2,500,000 acres of alluvial deposits of great depth, most of which is in the western part of the State. That the rainfall in the western part of Kansas within the drainage area of the river is small, of which but little reaches the river, except in times of unusual storms, and is inadequate to the cultivation of crops (64). That coextensive with the length and width of the valley is a volume of water underneath the land which is supplied from the river and is called an "underflow" (64). That this "underflow" at its normal height furnishes to the "bottom lands" in said valley, which are practically level and rise from 3 to 15 feet above the water level of the river, "moisture sufficient to grow ordinary farming crops in the absence of rainfall and furnishes water at a moderate depth below the surface for domestic use and for the watering of animals" (64). That nearly all these bottom lands are in private ownership; about three-fourths are occupied, and more than two-fifths have been in actual cultivation for many years, and nearly all are adapted to the growing of such cereals, grasses, vegetables, and fruits common to such altitude, and all are valuable for grazing purposes (65). That

outside of the cities and towns said bottom lands have a population of 50,000 (66). That the cities and towns in Kansas, on the borders of the river, have a population of over 60,000. That all the bottom lands were at one time public lands and that sections 16 and 36 were granted to Kansas for school purposes. That a part of the bottom lands were granted to it by the act of Congress of March 3, 1863 (12 Stat., 772), to aid in the construction of railroads and telegraphs in the State, and that prior to 1874 all the requirements and provisions of said act were complied with " by the State of Kansas and by the Atchison, Topeka and Sante Fe Railroad Company, as to such of said lands as were located east of the west line of Ford County in said State as now located," and that prior to 1874 the fee simple title to said lands had passed to said railroad company (66). That between 1874 and 1883 the remaining lands so granted to the State were conveyed by it, and that the amount of lands so granted to and conveyed by said State " was not less than 900,000 acres." That in extending the public survey over the lands in the Arkansas valley, in Kansas, the bed of said river was meandered, and said river from its mouth to the Colorado line became, was, is, and has always been, treated as a navigable river, and the bed of said river within said State of Kansas has never been sold or conveyed by the United States, and that the title and control of the bed of said river within the State of Kansas passed to the State by the act of admission (67). That the State owns 126.56 acres of said bottom lands in Ford County, which was granted to it by the United States for and upon which it now maintains a Soldiers, Sailors, and Marines' Home. That it is also the owner of 640 acres of the " bottom lands " upon which it maintains an industrial reformatory (68).

That the defendant, Colorado, under her constitution, claims the waters of said river and its tributaries in the State of Colorado to belong to the public and may be appropriated and used for domestic, agricultural, and other beneficial purposes (69, 70), and the said State has enacted laws authorizing the appropriation and use of the waters of said river and its tributaries for the purpose of irrigating nonriparian lands; and has attempted to grant to the codefendants and others the right to store said waters to irrigate nonriparian lands (70). That said codefendants, under the constitution and laws of Colorado, have attempted to acquire rights to divert waters from said river and its tributaries in the State of Colorado, " for the purpose of irrigating such arid nonriparian * * * lands in said State." That as a result of the exercise of such right " all of said waters are forever lost to such streams and are thus and thereby prevented from flowing into or through the State of Kansas " (70). That 4,300 cubic feet per second are thus appropriated and diverted in Colorado, while there are not in said river and its tributaries in said State over 1,400 cubic feet. That as a result of such appropriations " no portion of the ordinary flow of the said Arkansas river is permitted to pass into the State of Kansas," and " that no water flows in the bed of said river from the State of Colorado into the State of Kansas during the annual growing season, and the underflow of said river in Kansas is diminishing and continuing to diminish, and if the said diversion continues to increase, the bottom lands of said valley will be injured to an enormous extent, and a large portion thereof will be utterly ruined and will become deserted and be a part of an arid

desert" (71). That other diversions and appropriations of the waters of said river and its tributaries in Colorado are contemplated to irrigate lands therein "not now irrigated"(71). That "the State of Colorado and the said defendant corporations claim and openly assert their right and power to do as they please with all the water of the Arkansas river within the borders of Colorado (71), regardless of any rights which the State of Kansas or its citizens may have therein" (72). That since 1890 the State of Colorado has constructed a canal "for the purpose of diverting water of the Arkansas river from its channel * * * and using the water for irrigation purposes upon arid nonriparian * * * lands, so that the water will not return to or again flow in said river"(72). That said State intends to construct other canals for the same purpose, and also to construct reservoirs for the storing of the waters of said stream to irrigate arid lands in Colorado (72, 73). That during the time of the existence of the Territory of Kansas "all of the present drainage area of the Arkansas river in Colorado was * * * included" therein, and that the "common law and the riparian rights * * * extended over the whole Arkansas valley and to the summit of the Rocky mountains" during such time, "and had for many years prior thereto" (73).

That "by reason of the prior settlement, occupation, and title of the inhabitants of the State of Kansas upon and to the lands situate in the valley of said river, including those upon the banks of said river, the State of Kansas and the owners of land in said valley did acquire, and now have the right to, the uninterrupted and unimpeded flow of all the waters of said river into and across the State of Kansas. The rights so claimed by your orator accrued prior to any of the said diversions by or in the State of Colorado, and prior to the accruing of any of the pretended rights claimed by the State of Colorado, or by persons, firms or corporations now taking water from said river or its tributaries" (73).

That the diversions, appropriations, and use of the waters of said river by the defendants in Colorado "have greatly damaged and have irreparably injured the State of Kansas and the inhabitants thereof;" have diminished "the fertility of all the lands in said valley" and have damaged the said lands belonging to the State of Kansas; have occasioned the natural channel of the river in Kansas to be filled and obstructed "with drifting sand, dirt, and débris, until it is practically level with the lands adjacent thereto, and said obstructions are rapidly becoming permanent by growing vegetation, willows, and trees," causing said river to overflow the adjacent bottom lands and doing great damage thereto "at the times of sudden and excessive rainfall in the State of Kansas, or sudden and excessive melting of the snows in the State of Colorado" (73, 74), and have caused the value of the lands in the Arkansas valley in Kansas to shrink many millions of dollars, thus reducing the taxable wealth of Kansas and its revenues (66).

The relief demanded is—

(1) That the State of Colorado be enjoined "from granting, issuing, renewing, or permitting to be granted or issued or renewed, any charter, license, permit or authority to any person, firm or corporation for the diversion of any of the waters of the Arkansas river or of any of its tributaries from their natural beds, courses and channels

within the State of Colorado, except for domestic use; or to construct, maintain and operate any canals, ditches, branches, laterals or reservoirs now in use in said State."

(2) That all the defendants be enjoined from diverting any of the ordinary flow of the Arkansas River or its tributaries "for purposes of irrigation, sale or merchandise" (75).

(2) ANSWER OF DEFENDANT, THE STATE OF COLORADO.

By its answer defendant, the State of Colorado, denies that the Arkansas River, either in the State of Kansas or in the State of Colorado, is navigable for commercial purposes (80) under the laws and departmental rules and regulations of the United States (81). It claims by reason of its sovereignty to have "the plenary and exclusive right and power to control and regulate the use of non-navigable waters within its boundaries." It alleges, among other things, that "the use of the waters of said stream by diversion thereof, and application of the same upon the lands in the valley of said river within the territorial limits of the State of Colorado, is essential to the life and well-being of the inhabitants of said valley in Colorado and the right of continued use of the said waters is as vital to said inhabitants as is the land on which they dwell" (80). It claims that the jurisdiction and rights of the State of Kansas, either in its sovereign capacity or as a landed proprietor, do not extend to the State of Colorado; that the sovereign rights of the State of Colorado are not servient to the sovereign rights of Kansas, and that the latter has no dominant estate in that part of the Arkansas River which flows in Colorado (80), and that this court is without jurisdiction in the premises (81). It alleges, in effect, that the lands in the valley of the Arkansas River in Colorado possess the same general characteristics as those within the western 150 miles of said valley in Kansas. It denies that any diminution of the flow of said river in Kansas is wholly or mainly attributable to the diversion of the waters of said stream in Colorado, or "that there has been any wrongful diversion of said waters within the State of Colorado"(81). It denies that the normal flow of the river at the State line "for any considerable period is upward of 2,000 cubic feet per second," and alleges "that in the absence of any irrigation in * * * Colorado * * * the normal flow," exclusive of flood periods, would at the State line "be less than 500 cubic feet per second of time" (81, 82). It denies that the tributaries of said river in Kansas are few in number, or that such tributaries do not furnish sufficient water to cause a continuous stream to flow in the bed of the river east of the ninety-ninth meridian. It alleges that east of said meridian there are numerous tributaries of said river, which furnish a large supply of water to it. It alleges that said river in Kansas drains an area of over 20,000 square miles, and that in the eastern half of the course of the river the rainfall is ample to create and continue a large stream of water. It admits that the rainfall in the drainage area of the river in western Kansas is light, but alleges that about all of such rainfall, by drainage or seepage, reaches the channel of the river. It denies that the usual rainfall in that part of the Arkansas River valley east of the ninety-eighth meridian is insufficient to raise crops. It admits that in the western part of said valley in Kansas

the rainfall is not sufficient for such purposes, and alleges that in that part of the valley in western Kansas the lands are irrigated from the waters of the Arkansas River in the same manner as in the said bill of complaint is alleged to be done in the State of Colorado (82). It denies that there is an "underflow" such as is alleged in the bill (82), but admits that there are underground waters in the valley of the river in Kansas outside of the channel of the stream, but "alleges the same to be the ordinary water table of the country" (82), and that it exists in the valley of the river in Colorado to the same extent as in Kansas (83). It denies that such waters furnish "sufficient moisture to grow ordinary farming crops in the absence of rainfall, unless the same were supplemented by a system of irrigation such as is used in the State of Colorado and in the western part of Kansas"(83). It admits that the evaporation from said river is rapid and great, and alleges that it is greater at the west line of the State of Kansas than it is at points farther east, and that such evaporation is greater in Colorado between the point where the river leaves the foothills and where it crosses the border between Kansas and Colorado, and that under the system of irrigation used in Colorado the injury, if any, resulting to the inhabitants of Kansas through the loss of water by evaporation is less than it would be if there were no such irrigation system in Colorado.

It admits that in the western half of Kansas there are many acres of arid uplands bearing grass upon which cattle may feed and that such cattle must have watering places. It alleges that the number of such watering places in the State of Kansas has been increased by irrigation in Colorado; that this increase has resulted from the return waters from irrigation in times when otherwise there would be a small flow in the channel of the river. It admits that if the surface flow of the water in the bed of the river should be wholly cut off from the State of Kansas the underground waters designated as "underflow" would diminish under the lands adjacent to the river. It alleges, however, that such diminution would result only because of the increased drainage resulting from such process, and alleges that the system of irrigation practiced in Colorado has not had and never can have the effect of wholly or materially cutting off from Kansas the surface flow in the bed of the river, and states that on the contrary irrigation in Colorado equalizes the flow of the river in the channel through the State of Kansas (83), thereby diminishing the volume of flood waters and increasing the supply in times of drought (84). It admits that the bottom lands in the State of Kansas east of the ninety-eighth meridian are fertile and productive and adapted to the growth of crops mentioned in the bill, but are also valuable for grazing purposes. It denies that said bottom lands are fertile or productive for agricultural or horticultural purposes, except by the aid of irrigation.

It denies that the value of the bottom lands in the valley of the Arkansas in Kansas is in any degree dependent upon the same being permitted to receive the benefits arising from the normal flow of the water in the river. It denies that the value of said lands have shrunk in any sum by reason of the taking of some of the water for irrigation purposes. It denies that the wrongs alleged against Colorado have resulted in any loss to the citizens of Kansas or to its taxable wealth or its revenue or to its school system (84).

It admits the allegations in the bill with respect to the school-land grant to the State and to the grant of the State for railroad and telegraph purposes. It admits, as alleged in the bill, that such lands have been conveyed to third parties by the State (84, 85).

It denies that the territory of the State of Kansas became part of the United States by the treaty with the French Republic of April 30, 1803, ceding Louisiana. It alleges that that portion of Kansas lying west of the one hundredth meridian and south of the Arkansas River was not derived under said treaty and never belonged to France, but that said part of Kansas was derived by the United States from the Republic of Texas, and that the latter succeeded in sovereignty over said territory the United Mexican States (85). It again denies that the Arkansas River is now or at any time has been a navigable stream in Kansas or has been treated as such, or that the bed of said river ever passed to said State, or that it is now or ever has been the owner of said bed, except that as a political organization it has sovereignty over the same (85).

The answer then refers to the acts of the legislature of Kansas of 1886 and 1891 in regard to irrigation of lands west of the ninety-ninth meridian.

It avers that all the conveyances or grants of land from the United States to the State of Kansas were made subject to all rights of water from the Arkansas River for irrigation purposes theretofore and thereafter to be acquired, and that said lands were taken by the State of Kansas and by its grantees with full knowledge that the waters of said river had been and were being appropriated in the State of Colorado for beneficial uses in the irrigation of land, that lands west of the ninety-eighth meridian in Kansas and Colorado could only be made valuable for agricultural purposes by irrigation, and that said State and said grantees all had full knowledge that all patents granted after July 9, 1870, should be subject to all accrued and vested water rights in said river (85, 86).

With regard to the lands described in paragraph 5 of complainant's bill, situate in Ford County, Kans., upon which the State has erected and maintained a soldiers and sailors' home, the answer alleges upon information and belief that the State of Kansas has not made and does not now make any beneficial use of the water flowing in the Arkansas River for the improvement of said lands or the maintenance of said soldiers' home. It denies that the value of said lands for farming purposes depends upon the flow of the water in the bed of the river or upon the so-called "underflow."

In regard to the lands described in paragraph 6 of the amended bill of complaint, in Reno County, Kans., upon which the State has erected a reformatory, defendant alleges, upon information and belief, that the State of Kansas has never made any beneficial use of the water of said river.

It denies that the legislature of the State of Colorado has passed laws authorizing and licensing the diversion of water from said river or has granted to any person, firm, or corporation the right to make such diversion. It alleges, however, that said legislature has at all times recognized the right to make such diversion as one existing independent of any action by it and as one founded on necessity and on the usages and customs of the arid region of the United States, and that said legislature has never assumed the power either

to grant or restrain the use of the waters of the Arkansas River for irrigation otherwise than to regulate and control the diversion for such purposes by appropriate legislation (86, 87).

It denies that as a result of the exercise of the right to take water from said river in Colorado for irrigation purposes all of the waters are forever lost to said stream or are thereby prevented from flowing into the State of Kansas. It alleges that as a result of the irrigation system in vogue in Colorado the flow of said river in the State of Kansas is equalized and that the danger from floods is diminished and the supply of water in times of comparative drought increased.

It denies that as a result of appropriations of water in Colorado the total average flow of the Arkansas River and the total average flow of its tributaries is taken out, used, or absorbed, as in the bill of complaint alleged. It denies that any considerable portion of the ordinary flow of said river is prevented from passing into Kansas and alleges that the major part of the aggregate amount of water derived from the channel of the river in Colorado enters the said stream and channel by way of drainage or seepage and continues to flow into and through Kansas. It admits the allegations of the complaint that ditch owners of Colorado are diverting from the natural channel the waters flowing in the bed of the river and its tributaries (87).

It denies that the State of Colorado or the corporations joined with it as defendants assert any right or power to do as they please with all the waters of the river in Colorado regardless of the rights of Kansas and its citizens. It recites, however, that said State and other defendants have the right and power to apply the waters of the river within the borders of Colorado to beneficial uses by way of irrigation, etc. (87, 88).

It admits that a canal was commenced about the year 1890 near Canon City, Colo., under State control. It alleges that construction thereon was thereafter abandoned, and alleges that no water has at any time been diverted from the river into and through this canal (88).

It admits that the State has constructed certain reservoirs with money appropriated by its legislature for the purpose of storing storm and flood waters of certain tributaries of the Arkansas River 88).

It denies that when the Territory of Kansas was created or at the time the State of Kansas was admitted into the Union the water of said river was wholly unappropriated. It alleges that numerous appropriations of water had been made from said stream for irrigation purposes long prior to the creation of said Territory and that many more appropriations were made previous to the conveyance by the Government of the United States of any of the lands lying along or adjacent to said stream; that the necessity and right to divert the water of said river for the reclamation of arid land had long previous to the creation of said Territory been asserted and exercised by persons in possession of said lands, and said necessity and right were thereafter recognized by the legislature of the Territory of Kansas.

It denies that by the taking of water from the river in the State of Colorado for irrigation purposes the State of Kansas or any of its citizens has been injured to any degree whatever or that the fertility

of the lands or the use thereof to the fullest extent to which they are capable have been diminished or impaired, or that the crops, trees, or vegetation growing along said river have perished or will perish, or that the wells have become or will become dry, or that the salubrity or healthfulness of said valley or any of the lands adjacent to said river have been or will be impaired (89).

It denies that by reason of the diversion of said waters in Colorado for irrigation purposes the bed of the river during the summer season above the city of Wichita in Kansas becomes practically or wholly dry at any time, and alleges that if in any part of Kansas the bed of the stream or its natural channel is becoming filled with drifting sand, dirt, etc., or if at the time of sudden or excessive rainfall in the State of Kansas or the sudden or excessive melting of snows in Colorado the flood waters can not flow down the natural channel of said river, thus causing injury to the bottom lands, etc., and injuring or decreasing their value, that such facts are not attributable in any degree to the irrigation system within the State of Colorado, but to other causes entirely. It further alleges that the evils so alleged to exist by the State of Kansas are diminished rather than intensified by the existence of the irrigation system of the State of Colorado (89, 90).

It alleges that the appropriation of the waters of the river in Colorado were made in accordance with and in reliance upon the doctrine respecting the appropriation of the water of natural streams for irrigation, etc., which by usage and custom prevailed in the arid region of the United States and which have been recognized and approved by the United States.

That prior to the acquisition of title to any of the lands acquired by the General Government from France, Mexico, and Texas between the Mississippi River and the Pacific coast, the Government caused said lands to be explored and reported upon for the purpose of ascertaining their resources, climatic characteristics, etc., and that it became known to the Government and its inhabitants that from the ninety-eighth meridian to the coast the land was an arid waste (90); that the soil could not be made productive or minerals abstracted, nor could the land be inhabited except by the diversion of water from the natural streams and the application thereof to agricultural and mining purposes, and that in that portion of the land so acquired which lies south of the Arkansas River the laws and customs there prevailing authorize and sanction the diversion and use of water for agricultural and other useful purposes in contravention of any right or riparian owners (90, 91).

That the Government of the United States long prior to this sale by it of any of the public lands in the Arkansas valley recognized and approved the doctrine that water could be taken from a natural stream and applied to land for irrigation and other useful purposes, and that he who is prior in time is prior in right, and that the Government had disposed of its land in accordance with said doctrine (91).

That by means of the diversion and use of the waters of natural streams many million acres of the public lands in the arid region have been settled upon and improved, and title thereto has been obtained from the Government in the belief that the United States had

accepted and applied to said public lands the doctrine of appropriation of waters for beneficial purposes (92).

That the legislature of the Territory of Kansas in 1859 recognized such right of diverting for irrigation purposes the waters of certain streams in said Territory; that the legislature of the State of Kansas in 1868, 1886, and 1891 recognized such doctrine for the western part of the State of Kansas (92); that in reliance upon the approval and adoption of said doctrine about 500 miles of canals and ditches have been constructed in Kansas west of the ninety-ninth meridian, costing in the neighborhood of $2,000,000, and the waters of the Arkansas River in western Kansas have been appropriated and applied to about 150,000 acres of land in said State. That the Congress of the United States by the act approved July 26, 1866, recognized and approved the doctrine of appropriation of waters for irrigation purposes; also by the act of July 9, 1870, by the act of March 3, 1877 (93), by the act of March 3, 1891, by the act of August 18, 1894, and by the act of June 17, 1902. The Government also recognized the doctrine of appropriation of water for irrigation purposes by the act of October 2, 1888, which appropriated $229,000 for the purpose of investigating the extent to which the arid region of the United States might be redeemed by irrigation, and also by the appropriation made March 2, 1889, of $450,000 for like purposes (94).

That the provisions of the constitution of the State of Colorado set forth in the amended bill of complaint were adopted in harmony with and in pursuance of the policy of the United States in respect to the diversion and use of water in the irrigation of land; that the provisions in said constitution were accepted and approved by the action of Congress admitting Colorado into the Union (94); that the grants and patents of land in the valley of the Arkansas in the State of Kansas were made by the United States subject to the doctrine of appropriation above set forth, and were accepted by the several grantees with the knowledge that in the sale and disposition of the lands of the United States along said river west of the ninety-seventh meridian it had been and would be necessary to divert and use waters of said river in the improvement and cultivation thereof (95).

That many of the appropriations of waters from the Arkansas River in Colorado complained of were made prior to the creation of the Territory of Colorado and while same was a part of the Territory of Kansas; that in 1865 68 ditches and canals were constructed in Colorado, and 615 cubic feet of water per second of time were diverted from the Arkansas River and its tributaries, and have at all times since been used in irrigation; that between 1865 and 1870 127 additional ditches were constructed, and 458 cubic feet of water per second were diverted from said river and its tributaries; that additional ditches were constructed and water appropriated from said river and its tributaries between 1870 and 1880 and between 1880 and 1890; that in the construction of said ditches, canals, and reservoirs connected therewith many millions of dollars have been expended; that towns and villages have grown up in the valley of the Arkansas in Colorado, having population of more than 100,000; that in 1879 and 1881 the legislature of Colorado enacted certain statutes providing for the adjudication of rights to water by appropriation for agricultural uses of streams in said State, by which irrigation dis-

tricts were created along the entire length of the Arkansas River in the State, under which act a method was provided for ascertaining the amount of water each party claiming water was entitled to (95–96); that the inhabitants of the State of Kansas well knew that west of the ninety-eighth meridian to the Rocky Mountains the land was arid and incapable of being settled or cultivated except by irrigation; and that water was being diverted from the Arkansas River for that purpose (96); that prior to the bringing of this suit neither the State of Kansas nor the owners of land in the Arkansas valley in said State complained of the diversion of water in the Arkansas River, but, on the contrary, said State by its legislature approved of the diversion of the water from the river for irrigation purposes; that the State of Kansas and owners of land in the valley of the Arkansas River in said State have at all times acquiesced in the appropriation of water in the State of Kansas for irrigation purposes (97); that upon information and belief defendant avers that the owners of land along the river in the State of Kansas west of the ninety-eighth meridian have refused to assert or maintain any right to the flow of the water of said river as against the right to divert and apply the same to agricultural and other beneficial purposes in the States of Colorado and Kansas; that the Arkansas River through Colorado and Kansas has a broad, level bed of sand seldom entirely covered with water, the ordinary flow running in thin sheets in tortuous and constantly changing channels in the river bed; that from the mountains of Colorado to 400 miles eastward the watershed is barren and treeless, without any vegetation except short grass common to the great plains; that the precipitation of moisture is about 14 inches, most of which falls in local and violent storms and is discharged rapidly into the river, and the soil is not saturated by it; that the stream's tributaries are usually dry, discharging water into the river only in case of storms (98); that the waters supplied to the river for about 400 miles of its course are irregular in discharge, constantly varying in quantity and not sufficient to cause a permanent flow during any season of the year; that the water in the river changes daily and even hourly; that long before irrigation was adopted and applied in Colorado the volume of the water in the river constantly diminished, and this diminution was more marked as the river passed beyond the area of the local storms caused by the mountains; that the ordinary flow of the river in Kansas has been diminished by the destruction of timber on the watershed of said river in the mountains of Colorado and by the extension westward of the cultivated area of land in Kansas and by the sinking of wells in western Kansas; that the canals, ditches, and reservoirs in Colorado complained of are within 150 miles of the mountains, and the water is diverted from the river into said canals, ditches, and reservoirs, and the waters which are not so diverted would be lost by seepage and evaporation and would not reach the State of Kansas; that the waters of the Arkansas River diverted in Colorado are those which fall within the watershed of the river in said State, and are used and diverted only upon such lands within said watershed as need the same for domestic and irrigation purposes (99); that seepage and return waters have been increased as the irrigated area has moved eastward, and that the flow of the river is more continuous at many points than it was formerly, prior to the development of the irrigation system in Colorado (100).

(3) ANSWERS OF THE OTHER DEFENDANTS.

The answer of the Graham Ditch Company (101–123), of the Arkansas Valley Sugar Beet and Irrigated Land Company (125–152), of the Fort Lyon Canal Company (153–162), and joint and several answer of the Rocky Ford Canal, Reservoir, Land, Loan and Trust Company, the Catlin Consolidated Canal Company, the Oxford Farmers' Ditch Company, and the Laguna Canal Company (in the amended bill called the Lake Canal Company) (163–189), though differing somewhat in form from the answer of the State of Colorado, in substance are the same and raise practically the same issues.

The answer of the Colorado Fuel and Iron Company (190–208) to the amended bill is the same in substance and effect as the answer of the State of Colorado, except that it is alleged therein, among other things, in substance, that said company has acquired the ownership of certain water rights along the Arkansas River from parties who have made appropriations for irrigation purposes, and that it so acquired said rights for the purpose of supplying its steel plant at Pueblo, Colo., and other industrial enterprises which it owned, with water for mining and manufacturing purposes; also for domestic purposes; and that it has not used any of the water so acquired for irrigation purposes. Further, that it has constructed reservoirs along said stream in Colorado for the purpose of storing water to be used for mining and manufacturing purposes.

(4) REPLICATIONS OF COMPLAINANT.

The State of Kansas filed a general replication to each of the foregoing answers (211–228).

(5) PETITION OF INTERVENTION ON BEHALF OF THE UNITED STATES.

The first paragraph of the said petition describes the Arkansas River from its source to its mouth, and alleges that it is not navigable in the States of Colorado and Kansas nor the Territory of Oklahoma, but is navigable in the State of Arkansas and the Indian Territory (235).

In the second paragraph it is alleged that the lands located within the watershed of the river west of the ninety-ninth degree of longitude are arid lands.

The third paragraph (236) alleges that within said watershed there are 1,000,000 acres of public lands that are uninhabitable and unsalable.

The fourth paragraph alleges that said lands can only be made habitable, productive, and salable by impounding and storing flood and other waters in said watershed to the end that the said waters may be used to reclaim said land.

The fifth paragraph alleges that there is not sufficient moisture from rainfall to render the soil capable of producing crops in paying quantities in the watershed so described, and that they can only be made to produce crops by irrigation; that the common-law doctrine of riparian rights is not applicable to conditions in the arid region and has been abolished by statute and by usage and custom; that there has been established in its stead in said region a doctrine to the

effect that the waters of natural streams and the flood and other waters may be impounded, appropriated, diverted, and used for the purpose of reclaiming and irrigating the arid land therein, and that the prior appropriation of such waters for such purpose gives a prior and superior right to the water of the stream.

The sixth paragraph alleges that legislation of Congress, decisions of courts, and acts of the Executive Department have sanctioned and approved the use of water for irrigation purposes in the arid region and that he who is prior in time is prior in right, and that it is recognized that the common-law doctrine of riparian rights is not applicable to the public land owned by the United States in the arid region (236, 237).

The seventh paragraph alleges that in accordance with and in reliance upon the doctrine of the use of water for irrigation purposes the inhabitants of the arid portion of the United States have appropriated and used the waters of streams therein to reclaim and make productive and profitable about 10,000,000 acres of land, which now support a population of many millions, and that the inhabitants of Colorado and Kansas within the watershed of the Arkansas River have by irrigation from said river made productive and profitable about 200,000 acres of land, which provide homes for and support a population of many thousands.

The eighth paragraph alleges that the common-law doctrine of riparian rights is not applicable to riparian lands within the arid region, and that only by the use of waters of natural streams and flood waters for irrigation and other beneficial purposes can the lands in the arid region be made productive, and only by such use can additional areas be reclaimed and rendered productive and salable.

The ninth paragraph recites the passage of the so-called reclamation act of June 17, 1902.

The tenth paragraph alleges that about 60,000,000 acres of land belonging to the United States within the arid region can be reclaimed under the provisions of the so-called reclamation act (237, 238).

The eleventh paragraph alleges that the amount of land that can be so reclaimed will support a population of many millions.

The twelfth paragraph alleges that under the operation of the said reclamation act 100,000 acres of public land can be reclaimed within the watershed of the Arkansas River west of the ninety-ninth degree west.

The thirteenth paragraph alleges that the lands when so reclaimed will support a population of not less than 50,000.

The fourteenth paragraph alleges that under the operation of the so-called reclamation act about $1,000,000 has been expended in exploring, procuring, and setting apart sites upon which reservoirs and dams contemplated by the act can be constructed and maintained; that contracts have been let for the construction of reservoirs, which, when completed, will cost over two millions and will have a storage capacity to reclaim 500,000 acres of arid land, which land when reclaimed will sustain a population of not less than 250,000; that plans are contemplated for the expenditure of $20,000,000 under said act, to irrigate about 1,000,000 acres of arid public lands.

The fifteenth paragraph recites that there are $16,000,000 available under the so-called reclamation act (238).

The sixteenth paragraph sets forth the contention of Kansas as seen in its amended bill of complaint, viz., that it is entitled to have the waters of the Arkansas River, which rises in Colorado, flow uninterrupted and unimpeded into Kansas.

The seventeenth paragraph sets forth the contention of Colorado in respect to its claim of ownership, viz., that under the provisions of its constitution it is the owner of all waters within that State.

The eighteenth paragraph is as follows:

"That neither the contention of the State of Colorado nor the contention of the State of Kansas is correct; nor does either contention accord with the doctrine prevailing in the arid region in respect to the waters of natural streams and of flood and other waters. That either contention, if sustained, would defeat the object, intent, and purpose of the reclamation act, prevent the settlement and sale of the arid lands belonging to the United States, and especially those within the watershed of the Arkansas river west of the ninety-ninth degree west longitude, and would otherwise work great damage to the interests of the United States" (239).

The nineteenth paragraph, among other things, calls attention to the importance of a speedy and final settlement of the two main questions raised by Kansas and Colorado, respectively.

The twentieth paragraph prays that the Government may be allowed to intervene.

IV.

THE EVIDENCE.

(1) THE EXTENT AND CHARACTERISTICS OF THE WATERSHED OF THE ARKANSAS RIVER.

(*a*) *Its area.*

In the opinion of the court, overruling the demurrer of Colorado to the original bill of complaint, it was stated, among other things, that proof should be made as to the "extent of the watershed or the drainage area of the Arkansas river."

Defendant Colorado's Exhibit No. 3, introduced in evidence in connection with the testimony of Louis G. Carpenter, State Engineer of Colorado, shows such area. In regard thereto witness stated, among other things, as follows (619):

"Referring to defendant Colorado's Exhibit 3, I will state that this map was prepared in my office from the official maps of the United States Land Office, with the exception of Texas. There is no public land in Texas belonging to the United States, and the portion shown there came from the State map of the State of Texas. It was prepared to show the drainage basin of the Arkansas river from its source to its mouth (619). It lacks a little of the area of its watershed—that is, the portion covered by Missouri—because we did not have an official map of Missouri. So there is a little missing, which can be supplied. What drainage comes from the State of Missouri not shown on Exhibit 3 would come into the river far below either Kansas or Colorado through tributaries that are shown in part on the map, such as the Grand river, which enters the Arkansas river in the Indian Territory, and the White river in the eastern part of

Arkansas. There are colors on the map which separate the upper Arkansas proper from the drainage of the Cimarron and also another color which separates th Cimarron from the Canadian. The Cimarron enters the Arkansas river in Oklahoma, possibly thirty miles south of the Kansas line. The Canadian enters the Arkansas river in the Indian Territory a little west of the line of the State of Arkansas. The Grand river enters the Arkansas from the north side in the Indian Territory, a little west of the Arkansas State line. The Grand and Verdigris come in nearly together. No part of the waters of the Grand, Cimarron or Canadian rivers reach the Arkansas until that river has passed through Colorado and Kansas (619, 620).

"The approximate drainage area of the Arkansas river in Colorado is 26,000 square miles, and in the State of Kansas 20,000 square miles. That excludes the portions of the Grand and Cimarron which enter the Arkansas below the Kansas State line.

"The drainage of the Grand and Verdigris combined amounts to about 20,750 square miles; of the Cimarron 18,500 square miles; of the Canadian over 46,000 square miles. These latter areas are taken from the census reports. Combining all of these, the figures for the Arkansas river and its tributaries would show a total drainage area of 186,000 square miles, in round numbers. There is one large tributary near the mouth that is not given on the map, that has an area nearly as large as that of the Canadian. These drainage areas of the Arkansas river and its tributaries appear upon defendant Colorado's Exhibit 3 in words and figures. Describing the Arkansas river, the whole of the river is shown on defendant Colorado's Exhibit 3. The Canadian drainage and the Cimarron drainage are, as shown by the map, practically as important as the main river above their junction. The name 'Arkansas' is applied to the northern branch of the three. It heads in the Rocky Mountains, close to Leadville, and thence takes a generally southeasterly course until it reaches the exit from the mountains near Canon City, thence a more easterly course through the State of Colorado and into Kansas. In Ford county it turns abruptly northeast to the vicinity of Great Bend in Barton county, and thence again to the southeast to Wichita in Sedgwick county, and then a more southerly course until it passes the Kansas line. The distance to the State line of Colorado from the source is 357 miles. To the point where it crosses the Kansas line leaving that State, it is close to 750 miles. These distances were obtained by going over the detail maps (620). They are stated from memory, but are approximately correct. The head waters, being in the mountains, are then at a high elevation, as the mountains around Leadville are close to fourteen thousand feet high. The two extreme forks start from near Fremont Pass and Tennessee Pass. The latter pass is the one that the Denver and Rio Grande Railroad goes through in crossing the continent. The amount of watershed as shown by the map is narrow but broadens as it reaches the plains. The tributaries include some in the extreme mountains, but the greater part are outside of the mountains. In the mountains near Leadville are Lake Fork, Tennessee Fork, and the East Arkansas. As we pass down the river another lake fork or creek comes from Twin Lakes and various other tributaries that flow in from one side or the other. The left hand or northern watershed in the mountains is narrow. The principal part of the river lands in the vicinity of Leadville are

meadows, marsh and hay lands. The river falls with great rapidity for the first few miles, so that opposite Leadville, where it is very near the head, it has dropped to an elevation of nine thousand feet in about fifteen miles. It falls for that distance something like one hundred and fifty feet to the mile. From Leadville to Salida in Chaffee county, at the junction of the Little Arkansas, the valley is more or less open. It has some meadows and hay land. Below Salida it narrows up into a canon or gorge with comparatively little land on either side of it. The area of the high watershed is relatively small. The area of land above timber line is small in proportion to the whole amount in the watershed. The Little Arkansas, coming from toward Marshall Pass and entering near Salida, makes practically the last tributary of any importance of a mountain character. There are others, like Texas creek, Grape creek, etc., but these are not what might be termed entirely of mountain character. It is desirable to make a distinction betwen these streams. There is a very marked type of streams in the mountains. They are perennial in character, of rapid flow, supplied largely by springs and melting snows until late in the season. They are marked by freshets at the time of melting snow early in the season. Below the Little Arkansas to Canon City the streams mostly lie at a lower elevation. The snow does not lie long on the ground nor remain late in the spring. They are supplied by melting snows in the spring and by mountain rain storms, but run dry—at least they do now. Such are Texas creek, Grape creek, Hardscrabble creek, Four-Mile creek, the Fountain and the St. Charles. These streams all head in the mountains. Texas creek, Hardscrabble, Beaver, Four-Mile or Oil creek, really enter before it passes out on the plains. They are of a transitional type, not perennial mountain streams, nor are they quite of the plains type. The distinction is important as showing the general character of the water supply. The Fountain, which enters the river at Pueblo from the north, drains the region near Pikes Peak and then passes out on the plains and has for a great part of its course the typical plains character (621). The St. Charles, Apishipa, Huerfano, and Purgatoire are of the same character. They head in the mountains, and in the first part of their course are running streams, and have the same characteristics as the upper Arkansas. Then they pass out of the mountains onto the plains with a less rapid fall and a sandy bed. These streams then practically disappear and do not reach the main river. They sink. They have both the mountain character and the plains character. The largest part of the drainage is outside of the mountains, a relatively small part being in the mountain watershed.

"Following down the river we then have a series of streams that are of the plains character, pure and simple; that is, they rise in the plains, their course is through the plains and they enter the river on the plains. This includes all of the streams below the Purgatoire. It also includes some above—short streams that head outside of the mountains, such as the Chico, Horse, and Adobe creeks and any number of creeks that are called creeks but really are water courses or beds that streams do not often occupy.

"Referring to Defendant Colorado's Exhibit 3, the designations on the map do not all represent flowing streams. Many of these so-called streams are almost universally dry. Most of them are simply

depressions. They are often called gulches or arroyos. Locally a great many are called dry creeks. These streams would be more properly represented on such a map by dotted lines, which method is adopted on many Government maps. Some Government maps so show a part of the Arkansas river. All over Colorado we find innumerable creeks of this kind called 'dry creek' or 'sand creek.'

"At the present moment I can not give definitely the drainage of the Arkansas river which lies in what might be called the high mountains. The area of the river above Canon City is about three thousand square miles, but that includes all of the moderate elevations, from five thousand feet up. Generally speaking, the high area is small. I will furnish more accurate figures later.

"Canon City is about one hundred and fifty miles from the head of the stream, and Salida is about sixty miles west or up the stream from Canon City. A large part of this intervening country is of a moderate elevation and is a very dry country, a country which produces very little water except in times of storms. It is rocky and the water that comes comes in freshets.

"Texas creek and Grape creek are about the largest streams entering the Arkansas river between the mouth of the Little Arkansas river near Salida and Canon City. (Objection.) They are not streams which flow water constantly at the mouth. I know that in the upper part of Grape Creek there is a great deal of water, and ditches there. From the source of the Arkansas river the Tennessee Fork junction near Leadville is fifteen miles; to Twin Lakes creek thirty miles; to Salida eighty-one miles; to the Bessemer ditch headgate one hundred and sixty-nine miles; to Canon City one hundred and thirty-six miles (622); to Pueblo one hundred and eighty miles; to the Colorado canal two hundred and eight miles; to the Oxford Farmers' dam two hundred and fifteen miles; to the town of Rocky Ford two hundred and forty-eight miles; to the Fort Lyon canal two hundred and fifty-eight miles; to the mouth of the Purgatoire two hundred and eighty-six miles; to the Colorado and Kansas dam three hundred and nine miles; to the Amity canal three hundred and fourteen miles; to the Kansas-Colorado line three hundred and fifty-seven miles; to Coolidge three hundred and fifty-nine miles; to Syracuse three hundred and seventy-six miles; to Hartland four hundred miles; to Lakin four hundred and seven miles; to Garden City four hundred and thirty miles; to Dodge City four hundred and seventy-four miles; to Kinsley five hundred and twenty-one miles; to Great Bend five hundred and seventy miles; to Hutchinson six hundred and twenty-six miles; to Wichita six hundred and seventy-four miles; to Arkansas City seven hundred and thirty-four miles; to the Kansas-Oklahoma line seven hundred and forty-six miles. From Canon City to the Colorado-Kansas line it is two hundred and twenty-one miles by river as near as we could determine from maps on the largest scale we had. These distances are not in a straight line, but are the actual lengths on the river as near as it could be ascertained.

"Referring to the fall of the Arkansas river, at its extreme head you can put the elevation of most anything from ten to fourteen thousand feet. Fremont Pass is about eleven thousand feet, and Tennessee Pass three thousand three hundred feet. From there down to the junction of the first forks the river has a fall of one hundred feet and over to the mile; from that point to Canon City, at an elevation

of 5,330 feet, it has a fall of fifty to thirty feet per mile; from there to Rocky Ford the river drops altogether nearly twelve hundred feet, with a grade rapidly decreasing from Pueblo on. Down to Pueblo the grade is in the neighborhood of twenty feet per mile. From there to Rocky Ford it decreases to about seven feet to the mile. At Pueblo it has practically reached the plains rate of flow. From Rocky Ford to the State line the grade fluctuates from nine feet down to six feet per mile with a tendency to grow less as you go east. At the State line, with an elevation of 3,345 feet, the fall is probably between seven and eight feet per mile. At Garden City, at an elevation of 2,825 feet, the fall is between six and eight feet per mile; at Dodge City, elevation 2,465 feet, at Kinsley, 2,155 feet, at Great Bend, 1,840 feet, the fall between Dodge and Great Bend being nearly six and one-half feet per mile for the whole distance. At Wichita, elevation 1,300 feet, the fall is less than five feet to the mile. At the Kansas-Oklahoma line the fall is just about four feet per mile. At Arkansas City the elevation is 1,040 feet, so that the Kansas-Oklahoma line is just about 1,000 feet elevation, and the fall is about three to four feet to the mile" (623).

Intervenor's Exhibit No. 7, introduced in evidence at page 1373 in connection with the testimony of Elwood Mead, is a map of the drainage basin of the Arkansas River in Colorado and Kansas, prepared for the purpose of showing the irrigation canals and reservoirs along the Arkansas River and under the direction of Mr. Mead. A copy, in reduced form, will be found at the end of this abstract.

(*b*) *Precipitation.*

The precipitation in the Colorado watershed of the Arkansas River is about 14 inches per annum. At the Colorado-Kansas State line it is about the same (624), and at Dodge City, Kans., about 20 inches (624, 1828; see also Intervenor's Exhibit No. 17). At Hutchinson it is over 27 inches (1828), and at Wichita it averages over 30 inches. (See Intervenor's Exhibit No. 18).

(*c*) *Elevations.*

L. G. Carpenter (1839):

"In getting the elevations of cities in the State of Kansas, in many cases I have used Gannet's Dictionary of Elevations, published as Bulletin 160 of the United States Geological Survey, the third edition, dated in 1899, which edition I now have in my hands. It is a compilation, but is as good in most cases as any data we have at hand. Yes, sir, I will give you, from this dictionary, the elevations asked for, which are as follows: Coolidge, from the Santa Fe railroad, 3,348 feet; Syracuse, 3,227 feet; Garden City, 2,836 feet; Cimarron, 2,625; Dodge City, 2,484. These are the Rock Island elevations, while the others above are from the Santa Fe records. Kinsley, 2,171; Larned, 2,002; Jettmore, 2,268; Great Bend, 1,850; Scott City, 2,971; that is, this is called Scott, but I suppose it is the same; St. John, 1,915; Dighton, 2,761; Lacrosse, 2,061; Ellinwood, 1,789; Sterling, 1,644; Hutchinson, according to the Santa Fe Railroad elevations is 1,533; Buhler, 1,474; McPherson, 1,497; Medora, 1,484; Burrton, 1,457; Halstead, 1,388; Sedgwick, 1,377; Valley Center, 1,348; Wichita

Heights, 1,331; Wichita, Missouri Pacific railroad, on the authority of the Missouri Pacific railroad, is 1,202; Wichita, Santa Fe railroad, 1,300; Wichita, Rock Island railroad, 1,297; Oxford, 1,163; Eldora, 1,291; Augusta, 1,221; Winfield, Santa Fe railroad, 1,121; Kingman, 1,504; Pratt, 1,485; Greensburg, 2,235; Arkansas City, 1,073 feet."

(2) TESTIMONY IN REGARD TO THE QUESTION WHETHER COLORADO IS ACTUALLY THREATENING TO WHOLLY EXHAUST THE FLOW OF THE ARKANSAS RIVER IN KANSAS.

In the opinion of the court, overruling the demurrer, it was indicated that proof should be taken in respect to the above question (44).

(a) Complainant's Witnesses.

E. R. Chew. Direct examination (491):

Irrigation Engineer of the State of Colorado for Irrigation Division No. 2, which division covers the Arkansas River and all its tributaries in the State of Colorado.

Hold my commission by appointment from the governor of Colorado; draw my salary from the State. I regulate the amount of water that goes into each canal or ditch taking water from the Arkansas River and its tributaries in the State of Colorado, and also the amount of water that goes into the reservoir in division No. 2. My duties are regulated by statute and regulations promulgated by the State engineer (491). Am acquainted with the Bessemer ditch. It is owned by the Bessemer Ditch Company, a corporation. The ditch takes water out of the Arkansas River in Colorado. Its decreed appropriation is 364 cubic feet per second of time, of date May 1, 1887 (493–494). This ditch would irrigate about fifteen to twenty thousand acres. It is the first ditch below Canon City. It would average about four or five miles from the river, approximately. The next ditch is the Bob creek canal. If is about fifty miles long. Its decreed appropriation is 756.28 cubic feet, of date June 9, 1890. There are about thirty thousand acres of land under this ditch, but not all this land can be irrigated from the ditch. The average distance from the river is about five or six miles (494). The next canal down the river is the Rocky Ford Highline canal. It is seventy-five miles long, and at its farthest point is about twenty miles back from the river. It has a decreed capacity of 418 cubic feet, dated January 6, 1890. It absorbed prior appropriations, viz., Enterprise, 1867, 2.5 cubic feet; Ballow Hill, July 1, 1869, 16 cubic feet; Ballow Hill, July 1, 1885, 30 cubic feet; Allen, March 11, 1886, 2 cubic feet; Allen, 1890, 2.5 cubic feet. There are about 25,000 acres irrigated from the Highline on the north side of it. The next canal is the Oxford Farmers'. It is on the south side of the river. It is about 15 miles long. It has a decreed appropriation of 116 cubic feet, of February 26, 1887. There are about 26,000 acres under this canal. The next canal is the Otero, forty miles long. It has a decreed appropriation of 123 cubic feet, of March 3, 1890. Eight or ten thousand acres irrigated from it. The next canal is the Catlin (495), thirty-five miles long. Decreed appropriation of 248

cubic feet, of December 3, 1884, and a further appropriation of 97 cubic feet, from November 14, 1887. About 18,000 acres can be irrigated from this canal. The next canal is the Laguna or Lake, twenty-five miles long. Decreed appropriation of 155 cubic feet, of September 25, 1889. There is one reservoir in which this canal drains. Ten or twelve thousand acres of land can be irrigated from this canal. The next is the Rocky Ford ditch, on the south side of the river, fifteen miles long. Decreed appropriation of 111.76 cubic feet, of May 13, 1874. About six thousand acres can be irrigated from it. The next is the Fort Lyon canal, operated by the Arkansas River Land, Reservoir and Canal Company. It is on the north side of the river, 110 miles long. Decreed appropriation of 164.64 cubic feet, of April 15, 1884, and a further appropriation of 597.16 feet, of March 1, 1887. It can irrigate about 30,000 acres. The next is the Amity, on the north side, fifty miles long (496). Decreed appropriation of 283.5 cubic feet, of February 21, 1887. About 15,000 acres can be irrigated from it. The next is the Lamar canal, on the south side of the river, three miles below Lamar. It is about thirty miles long. It has decreed appropriations aggregating about 300 cubic feet. It can irrigate about 13,000 acres. The next is the Graham ditch, ten miles below Lamar, on the south side, about seven miles long. Decreed appropriation of 61 feet, dated August 24, 1891. Over 3,000 acres can be irrigated from it. The next is the Buffalo Creek ditch, on the north side of the river. Headgate about 18 miles below Lamar and 12 miles from the Kansas-Colorado line, eight miles long. It has a decreed appropriation of 57.5 cubic feet, dated January 29, 1885. It can irrigate about 3,000 acres. All these canals derive their water from the Arkansas river and its tributaries in Colorado. The total amount of the decreed appropriations is 3,997.31 cubic feet per second of time. The total amount of the land that could be irrigated from these several ditches amounts to 318,504 acres. The amount actually irrigated therefrom is 200,520 acres (497). There are other appropriations which have not been mentioned by me. The total amount of all the decreed appropriations of the Arkansas River and its tributaries is 10,248.56 cubic feet per second of time. The total amount of water filed upon for reservoir purposes from the Arkansas River and its tributaries is 1,139,490,773 cubic feet (498). There are certain rights recognized in reservoir companies that have built their reservoirs and made application for filing, the aggregate capacity of which exceeds 5,000,000,000 cubic feet (519). My official duties are to regulate the flow of water into each canal according to the amount in the river and their decreed priorities. If there is water enough in the river to supply each decreed priority, it gets the full amount if it wants it. If there is not enough to supply each of the decreed priorities, then I give it to them according to their decrees—that is, according to the age of the ditch (499).

The ditches I have referred to in the ordinary season use all the water they can get for irrigation purposes. Sometimes the season will not permit them to have any water at all, or only a very limited amount. Sometimes the season will give them their full decrees. These ditches referred to use up to the amount of the decreed appropriation when it is in the river to meet it. During the last few years

they have not been getting as much water as they want (503). If there was more water the ditches would use more. We use water all winter for irrigation. Most any crop can be increased by using water during the winter. Sometimes we have more water during the season of the year when the snows are melting than when they are not melting. Sometimes the snow begins to melt in March and continues until the first of June. It is very irregular, however, depending on the season, whether it is hot or cold (504). The date of the decreed appropriation of the ditches is supposed to be when the work was begun (505). The result of our distribution would be to take the whole flow of the river. We can't do it, because there is a large amount of seepage that comes in below here that runs into Kansas that we can't get hold of. We would get hold of it if we could.

Cross-examination by counsel for Colorado (506):

There are ditches along the Arkansas River in Colorado with appropriations dating back to 1859 or 1860. There are a great many 1861 ditches, and probably several hundred in 1862 and 1863. Seepage water is that which seeps back toward the river after having been applied to irrigation (506).

None of the ditches referred to by me takes the water beyond the lands drained by the Arkansas River and its tributaries, and the seepage water returns to the river or the tributaries. Water applied to the ground for irrigation in winter acts in a measure as storage for the coming season. The rainy season here is very indefinite. It may come as early as March, sometimes as late as October, and sometimes not at all. In recent years the melting of the snow has been hastened, so that the water runs off more in floods than theretofore (507).

Cross-examination by counsel for intervenor (510):

A cubic foot of water as I have used the term is $7\frac{1}{2}$ gallons passing a given point in a given time.

Redirect examination (517):

Kansas gets some of the water from the seepage ditches above. The water we take from the river for irrigation is distributed over the land back from the river varying from three to fifteen miles.

James Cowie. Direct examination (528):

"I am secretary of state of the State of Colorado. As such secretary of state I have in my office the original charters of all irrigation companies filed. I am the keeper of the great seal of the State of Colorado. I have the original charters of certain ditch companies before me now. These charters show filing as follows:

"The charter of the Bessemer Irrigating Ditch Company was filed on the 23rd day of May, 1888.

"The charter of the Twin Lakes Land and Water Company was filed on the first day of June, 1898.

"The charter of the Rocky Ford Canal, Reservoir, Land Loan and Trust Company was filed on the 7th day of December, 1889.

"The charter of the Oxford Farmers' Ditch Company was filed on the 12th day of October, 1888.

"The charter of the Otero Canal Company was filed on the 8th day of March, 1890.

"The charter of the Catlin Consolidated Canal Company, being a consolidation of the Catlin Canal and Land Company and the Fair-

mount Lateral Ditch and Reservoir Company, was filed for record on the 17th day of November, 1892.

"The charter of the Laguna Canal Company was filed for record on the 4th day of July, 1892.

"The charter of the Rocky Ford Ditch Company was filed for record July 27th, 1882.

"The charter of the Fort Lyon Canal Company was filed for record on the 10th day of July, 1887.

"The charter of the Arkansas Valley Sugar Beet and Irrigated Land Company was filed for record on the 22nd day of April, 1901.

"The charter of the Lamar Canal Company was filed for record on the 8th day of February, 1893.

"The charter of the Graham Ditch Company was filed for record on the 17th day of September, 1889.

"The charter of the Colorado Fuel and Iron Company was filed for record on October 21, 1892."

O. C. Emery. Direct examination. Kansas (529):

Live at Wichita. Am a newspaper reporter. Have been in Colorado and have seen most of the ditches and the head gates along the Arkansas River up as far as Pueblo. During the month of August, 1904, visited nearly all the dams and head gates beginning at Lamar, with the Amity dam first (530). The witness then went on to state that the dams near the head gates of the different ditches in Colorado were so constructed as to divert the waters from the river into the ditches, and that at times of ordinary flow in the stream all the water above the respective dams was diverted into the respective ditches.

(*b*) ***Intervenor's Witnesses.***

Elwood Mead, Chief of the Irrigation and Drainage Investigations, United States Department of Agriculture, on direct examination (1373–1377) said:

"In the investigations of conditions along the Arkansas river in Colorado and Kansas, I will say that there was a map made under my supervision showing the stream and the different ditches that have been taken out of the river in Colorado. That map is now before me while I am testifying."

It is Intervenor's Exhibit No. 7. In reduced form a copy of map is inserted at the conclusion of this abstract.

"* * * The natural streams on this map are shown in blue. Every 500-foot contour has been placed on the map, showing the elevations of the country. They are in brown and the ditches are in red. The boundaries of the different districts are in green and the county and State and township boundaries are in black.

"Now, taking up the extent of irrigation in the Arkansas valley in Colorado, the official records show that there are 1,837 ditches included in the decrees, and 659 ditches filed but not included in decrees, and of these ditches filed 124 have been reported as completed. The amount of water decreed to these different ditches is 9,459.25 cubic feet per second. The average daily diversion during the irrigation period of 1904 was 4,180.08 cubic feet per second. The total amount in acre-feet for the season of 1904 was 934,324. The

total area reported as being capable of irrigation from existing ditches is 553,984 acres. The total area irrigated in 1904 was 345,175 acres. The irrigation period as given here is the period in which water is reported as running. It varies in different canals from 345 days for the greatest to one day for the least. The average number of days of the irrigation period, as reported by all these canals, is 69, and the average depth of the water applied through the division is 2.76 feet. The earliest of these priorities is 1859, and the number of priorities established by decrees 2,477 (1373, 1374).

"Taking up the storage of water in this valley, the number of reservoirs included in the decrees is 47; the number of reservoirs known to exist is 58; and the available storage capacity of these reservoirs in acre-feet is 243,277.

"From the records of the State engineer's office the following information with respect to water filings in 1903 and 1904 has been obtained:

"Total number of ditch filings, 109.

"Total amount of water claimed, 9,690 cubic feet per second.

"Total number of reservoir filings, 64 (1374).

* * * * * * *

"We have on this stream over 2,000 different appropriations, over 2,000 different ditches taking water, and they are scattered over a country over 200 miles in length and more than half as wide. * * * We have here [producing map] a graphical presentation of the flow of the Arkansas river as measured at different points along its course in Colorado. We have no record of the flow in Kansas.

"Q. In this connection, do you desire to refer to some paper or map which you have prepared in order to explain your testimony?

"A. Yes.

"Q. State what that paper is.

"A. This is the paper that I hold in my hand at present. The total discharge in acre-feet of the Arkansas river for the months of May, June, July, August and September, for the years 1901, 1902 and 1903, is shown by this paper."

The said diagram, marked "Intervenor's Exhibit 8," was offered in evidence.

"This diagram, marked 'Intervenor's Exhibit 8,' shows by the relative sizes of the respective squares the total discharge at the different stations along the river where records of the flow have been kept. These records have been kept in part by the United States Geological Survey, and in part by the Colorado State engineer's office. Now, to show how greatly they vary at different points, we will take Salida, the station farthest up stream. There in 1901 the discharge—I will not give anything except the hundreds of thousands—was 245,000 acre-feet; in 1902 it was 117,000, or less than one-half; in 1903 it was 323,000, or nearly one-half more. Now, going down to Pueblo, in 1901 the discharge was 384,000 acre-feet (1375).

"Q. When you say that many acre-feet, it means that the water flowing in that stream for six months would cover that area one foot in depth?

"A. Yes. In 1902 at Pueblo it was 137,000, or just a little over one-third; and in 1903 it was 324,000. Now, I wish to call your attention to a fluctuation there that illustrates the difficulties—the complications—that come with the ordinary diversion of water, no matter how efficient your administration may be. At Salida in 1901 there was approximately one-third less water in the river than there was in 1903. That is, the greatest discharge at Salida was in 1903. Now, when we go down to Pueblo the greatest discharge was in 1901. There we have the percentages almost exactly reversed. The variations in rainfall evidently account for it. The difference between the amount of water that came into the river between snowfall in the upper part of the river and rainfall in the lower part completely changes the amount of water in the stream—the character of the stream. Not only is the total water supply in the stream changed, but the rate of increase or decrease in the stream changes in the two seasons, and you will find the same variations in the proportions between 1902 and 1903. * * * We have here some diagrams to show the fluctuations in the different months of these periods. The diagrams show the flow of the stream in the different months of the irrigation period at each of the different stations before named. Now, this set of diagrams shows the monthly fluctuations—or the monthly discharges of the Arkansas river in acre-feet and in cubic feet per second for the months of April, May, June, July, August, September, October and November, at Salida, for 1901, 1902, and 1903; also at Canon City, Colorado, at Pueblo, Nepesta, Rocky Ford, Prowers station, all in Colorado" (1376).

Said diagram was offered in evidence and marked "Intervenor's Exhibit 9."

On cross-examination of this witness, counsel for Kansas introduced Bulletin No. 140 of the Agricultural Department, prepared by Mr. J. S. Green, which shows, on page 29, the mean annual divertible flow of the Arkansas River in Colorado in cubic feet per second, which witness said was a reasonable estimate at any point in Colorado below Pueblo, and which is as follows:

January	660	July	3,250
February	700	August	1,100
March	800	September	700
April	1,030	October	690
May	2,630	November	720
June	4,370	December	720

(Said Bulletin No. 140 offered in evidence by complainant.)

(c) *Defendants' Witnesses.*

Louis G. Carpenter, State Engineer for Colorado, in effect testified that the State was not taking nor threatening to take any of the waters of the river (1826, 1851).

(3) WHETHER THE FLOW OF THE RIVER CAN BE WHOLLY EXHAUSTED IN VIEW OF SEEPAGE OR RETURN WATERS.

Louis G. Carpenter defines seepage or return waters as follows (632):

"The term 'seepage' as used in an irrigated country represents either the water that seeps into or out of a ditch—leakage. It is the percolated water or waste water lost by the slow percolation of the water through the interstices of the soil that disappears in invisible sources from a ditch. That would be the water lost by seepage. The water that comes into a ditch by seepage would be the water that comes in in numerous fine channels in the soil or by percolation through the soil. They are not channels, but simply an oozing out of the banks. The same is true as to streams. Seepage and drainage in a measure are the same. As to seepage water, we know its origin—that is, we know it comes from water supplied by irrigation. Seepage waters such as come from irrigated lands are similar for practical purposes to what might be called drainage waters from lands saturated to the same point by ordinary rainfall, but with us, when we use those terms, the universal application is to waters of this character put onto the ground, and the origin of them is easy to distinguish in this country because most of this region where seepage water is found was originally dry within the memory of man. The term 'return water' simply applies to these seepage waters as they come back to a stream, and the term has become quite well fixed in that regard. We take water out of a stream and spread it over the land for irrigation, and 'return waters' means the percentage that returns to the stream, and it becomes quite a marked addition to the stream. The term 'flood waters' is used to describe the sudden rises that occur in the more or less dry streams. It may be anything from a few inches flow to many feet."

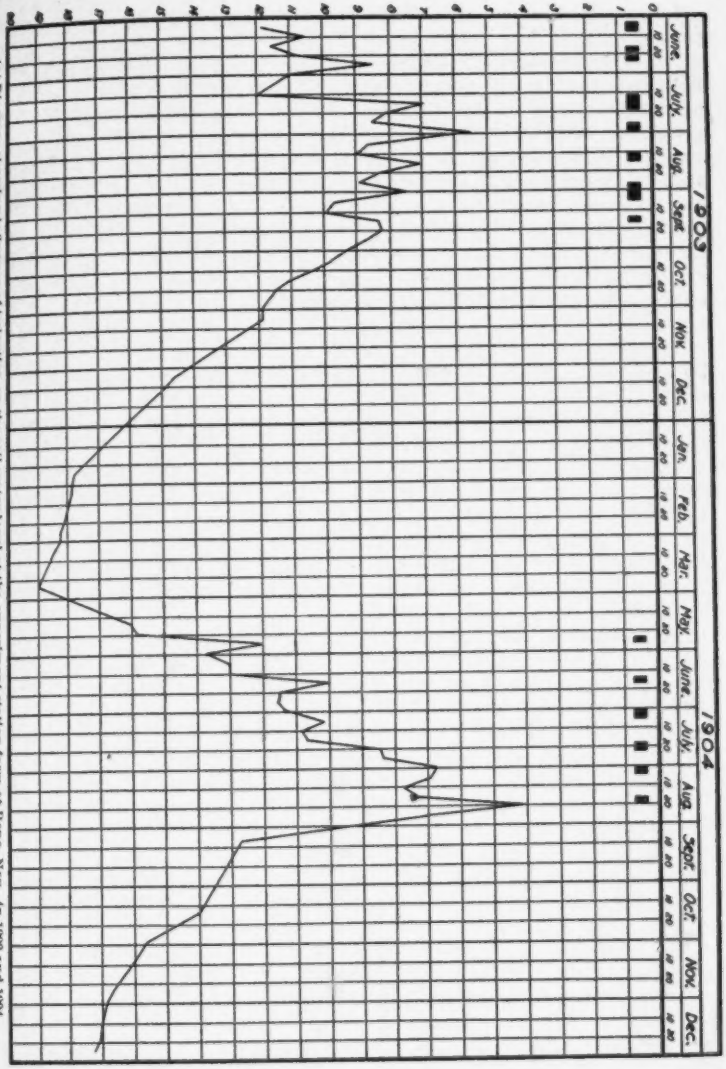
On the question of seepage or return waters Mr. Elwood Mead, on direct examination, testifies as follows (1379):

"The investigations with which I am connected have been from the first engaged in the study of problems of seepage and return waters as one of the factors that enter into the duty of water.

"Seepage water is very largely returned to the streams. They find their way down through subterranean courses and return to the stream or its tributaries. After the water sinks to a certain distance beneath the surface, then losses from evaporation practically cease and its subsequent disappearance is one of transit. It escapes back into the stream.

"I have a record of the rise and fall of the water in a well near Reno, Nevada, this record being kept as a part of the studies to determine the duty of water at that point. It is on the experiment station farm near Reno, and my record shows the effect that the waters in that canal had upon the rise and fall of the water in that well at that place for 1903 and 1904. I have a diagram which shows the dates on which this land is located that was irrigated. The well is a considerable distance from the ditch. It is not affected in any way by the seepage from the ditch. The entire change in the rise and fall of the ground water here comes, I believe, from the water used in irrigation" (1380).

Said diagram, being Intervenor's Exhibit 10, was offered in evidence, copy of which is here inserted:



(e) Diagram showing influence of irrigation on the soil-water level at the experiment station farm at Reno, Nev., in 1903 and 1904. (Intervenor's Exhibit No. 10.)

"Intervenor's Exhibit 10 includes two seasons, beginning with June, 1903, and ending with December, 1904. The immediate effect of each irrigation in the vicinity of the well is shown by the rapid rise of water in the well, and the influence of the general irrigation, the irrigation of the whole field, is shown by the continued rise of

soil water during the irrigation period, and then its continuous decline after irrigation ceased, the decline beginning with September, 1903, and ending in March, 1904, beginning again in 1904, in the latter part of August, and was still continuing when the record ceased in December. Now the significant feature about this rise and fall is that between the high-water point in 1903 and the low-water point in 1904 the fall was 13 feet. That means that enough water to saturate the soil to the depth of 13 feet was drained out after the irrigation of 1903 ceased before the irrigation of 1904 begun, and taking the percentage of water that a saturated soil will hold as between twenty-five and thirty per cent there must have been enough water returned to the stream as seepage from that field to have covered that land to a depth of between four and five feet. The total quantity applied to the field was about seven feet. Or, to put it differently, seventy per cent of the water applied to the field in irrigation returned to the stream as seepage.

"We have here a similar diagram showing the rise of water in the soil in the valley of Kings river in California, near Fresno, during the irrigation period, and the fall of that water in the soil after the irrigation period ended" (1380).

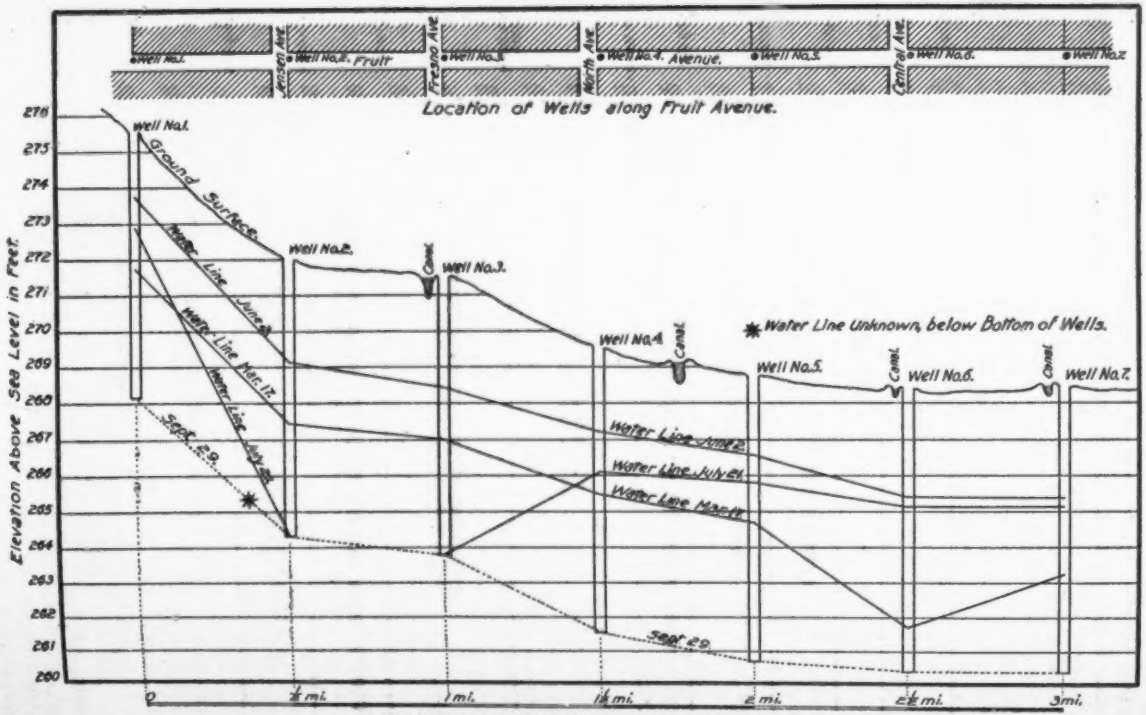
The said diagram, being Intervenor's Exhibit 11, was here offered in evidence, and copy of same appears at page 35.

"The purpose of this exhibit is to show how irrigation accumulates water in the soil and how that accumulation is afterwards discharged at other portions of the season back into the stream through seepage, in both instances the water surface in the soil being so far below the soil surface that the loss from evaporation would be very slight. Practically the entire fall is due to its escape as seepage back into the stream at a lower point.

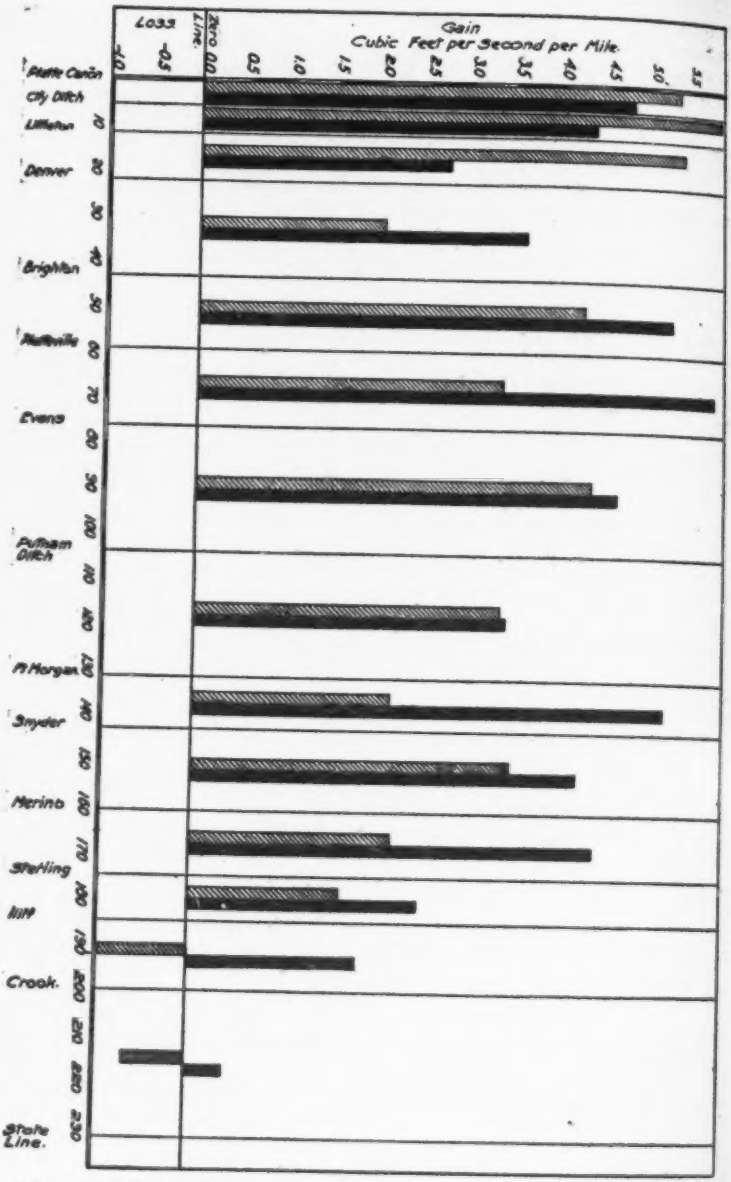
"During 1902 and 1903 I made a study of the return and seepage waters from the South Platte in Colorado. I have the result of that investigation in the form of a diagram, which I now have with me" (1381).

Diagram was offered in evidence as Intervenor's Exhibit 12 (objection by complainant), copy of which appears at page 36.

"This diagram is a comparative one. It shows the comparative volume of return seepage in the South Platte river for two seven-year periods. It is the average of those years for two seven-year periods, the first period being from 1889 to 1895 and the second from 1896 to 1903, excluding 1897. All the measurements in this time except for 1903 were taken from the reports of the State engineer of Colorado. Those for 1903 were supplied by the investigations of the Office of Experiment Stations of the Department of Agriculture. The hatched columns represent the gain per mile in the various sections for the first period, and the solid columns represent the gain per mile for the second period. The vertical scale represents cubic feet per second per mile, and the horizontal scale represents distances along the streams. It will take a little explanation to interpret this diagram, and in order to interpret it one needs to know something of the growth of irrigation along the stream. In the interpretation of the diagram I depend upon my personal knowledge of irrigation along that stream during the entire period.



(f) Diagram showing rise of ground water near Fresno, Cal.
(INTERVENOR'S EXHIBIT No. 11.)



(g) Diagram comparing volume of return seepage to South Platte River for two seven-year periods, 1889–1895 and 1896–1903, excluding 1897.
(INTERVENOR'S EXHIBIT No. 12.)

"We have taken the following points along the stream: Beginning with Platte Canon—that is, where the stream emerges from the mountains—the next is the head gate of the Pacific ditch, half way between the Platte Canon and Littleton; and then Denver, ten miles below; and then Brighton, a little over forty miles below; Platteville, not quite sixty miles below; Evans, between 70 and 80 miles; the Putnam ditch, between 100 and 110 miles; the Fort Morgan head gate, a little over 130 miles; the Snyder, between 140 and 150 miles; and ending with the State line, 230 miles. Now, during the first seven-year period, between Platte Canon and the City ditch, a distance of five miles, the average gain per mile from seepage was a little over five cubic feet per mile per second. During that period the gain was larger than it was during the second period, and the reason for that is that it was in the beginning of irrigation and there was a greater abundance of water than there is at present. A great deal of the irrigation was close to the stream. Since that time ditches have been extended farther away from the stream and the water is distributed over a wider area and is used in smaller quantities, and the consequence is that during the second seven-year period the return seepage has fallen to nearly a cubic foot per second per mile, the average for the last seven-year period being about four and a half cubic feet per second of time.

"Now, in a general way we find that in all of that older irrigated territory where water has become exceedingly valuable, where the territory embraced by those ditches has been extended farther and farther back from the stream, there has been a reduction in the return seepage. For instance, between the City ditch and Denver the return for the first period was about six cubic feet per second to the mile, and during the second about four and a half cubic feet per second per mile. Between Littleton and Denver the difference is more marked. Now, without going into the differences between all of these stations, we find when we go to the lower end of the stream, where, if there was any irrigation during that first seven-year period, it was new—it was so new that the subsoil had not filled up, and where, as a consequence, seepage water was not returning to the stream—we find, for instance, between Iliff and Crook, a distance of about fifteen miles, instead of their being any gain at all from seepage there was a loss in the quantity of water in the stream. The probabilities are that that loss was from evaporation. It might have been from both seepage and evaporation. But anyhow, during the first seven-year period there was a loss. The stream, instead of gaining, lost about a cubic foot per second per mile.

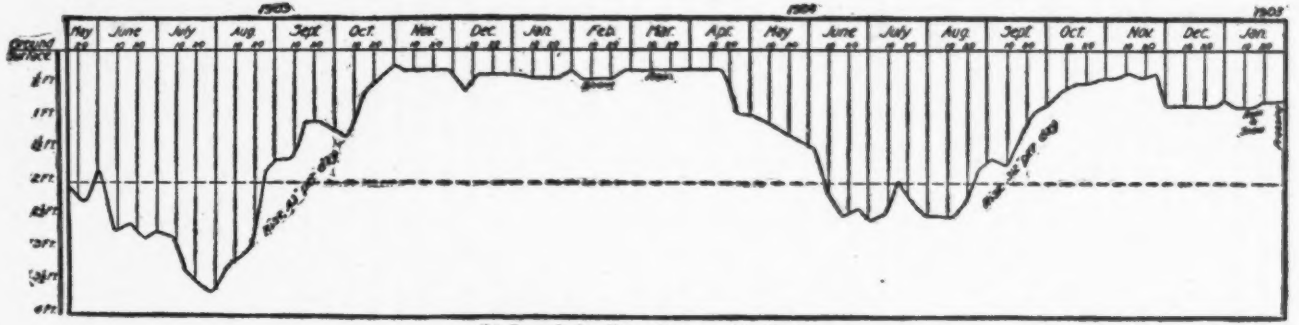
"Now, during the second period, a number of ditches that had been built in the earlier period have been continuously in use, and the water has saturated the soil on the lands that they irrigate, and it has begun to return as seepage, and so during the second period, where there was a loss in the first one, there is now, as near as I can estimate it here, a gain of about two cubic feet per second per mile. The same is true of the district between Crook and the State line, exactly the same phenomena. Where during the first seven-year period there was a loss in the river there is to-day a gain in the river, a gain not so marked as in the upper portion; which is due to the fact that irrigation is newer, the subsoil is not fully saturated and the watered area not so extended as in the other (1382).

"Now, I will say that this increase in return seepage is a universal action; it is a change that takes place in the flow of every stream that is diverted for irrigation. The tendency of irrigation is to act as an equalizer. The excessive diversions are always made when there is an excessive flow in the stream, and the water fills up the soil during that time, as was shown in these diagrams, then finds its way slowly back to the stream; that is, irrigation tends to diminish the flood flow of the rivers by diversion at that time and tends to augment the low-water flow, or at least the late flow of the river, by the return of waste and seepage water. Now, the exact time when seepage water will return to a river depends on the distance from the stream and the character of the soil of the irrigated land and of the soil that the water is to find its way through. We have here an interesting diagram that illustrates this [producing diagram]. This diagram shows the rise and fall of the water in a well near Sunnyside, Washington, in the valley of the Yakima River" (1382, 1383).

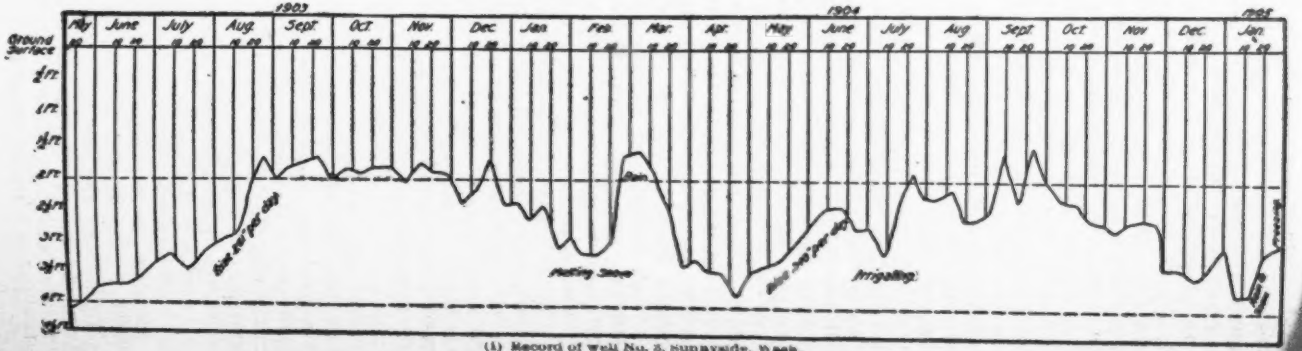
Said diagram, being Intervenor's Exhibit 13, was offered in evidence (objection by complainant), copy of same appearing at page 39.

"This diagram represents the rise and fall of the water in one of a series of wells which extended from a canal down to the river, this being the well farthest from the canal and nearest to the stream. I have not a complete set of diagrams here, but they, taken together, confirm the truth of the explanation made of this diagram. The variations in the level of the water in the soil begin with May, 1903, and end with November, 1904. Irrigation begins in April and continues during the summer months; but notwithstanding the water was being carried in this canal and used on the land under it, the water in this well continued to fall from May until the last of July, when it reached its lowest point. Now, in the wells nearest the canal the water responded immediately to its application to the land. The water in the well began to rise; and as we go away from the land the rise comes at a later date, so that there was a continuous retardation of the rise of soil water in the wells from the one nearest to the canal to the one farthest from it. It was a strip of land along the canal which was irrigated. Both influenced the well, but principally the land irrigated.

"Now, by the first of August the influence of that irrigation had reached this well; the water that had been filling the soil along the line of the canal and rising higher and higher as shown on the records of wells near the land irrigated had found its way down the slope through the intervening soil and reached the well from which this diagram was made, and the water in the well continues to rise during the months of August, September, October and November, and then we come to the time when it is impossible to tell whether it is the irrigation water or other causes that are influencing it, because the rainy season begins and snow and rain affect it. In any event, it keeps rising until April, and then, just at the time when irrigation begins, the level of the water in this well begins to fall, and it continues to go down again as before until about the 10th of August. It reaches its lowest point the last of July, just as the year before, but does not begin to rise perceptibly until about the 10th of August, and then it starts up and continues just as it did the year before, showing that the effects of irrigation about three miles away had taken that time to reach this point, and here in conditions like that you would have seepage water returning to the stream during the actual irrigation period


1903
1904
1905
May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan.
Ground Surface
Irrigating
Irrigating

(h) Record of well No. 19, Sunnyside, Wash.


1903
1904
1905
May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan.
Ground Surface
Irrigating
Irrigating

(i) Record of well No. 5, Sunnyside, Wash.
(Intervenor's Exhibit No. 13.)

rather than during a nonirrigation period as they would if the canal was closer to the stream or if the soil permitted of its more rapid passage. It is action of that character that explains in part the discrepancy between the volume of water diverted and the volume of water that is measured in many rivers at any particular point. I have not here at hand the records of the Arkansas river, but as I remember it the average flow of the stream as measured at Pueblo is about 1,000 feet per second. It is less than that. Yet we had diversions from that stream last year of over 4,000 cubic feet per second. That difference between 4,000 feet taken out of a stream which had only 1,000 feet in it where measured is due in part to the fact that that measurement is made after the diversions in the mountains and on a great many of the tributary streams. It does not take into account the effect of the diversions above, nor does it take into account the influence of the seepage water that returns. And that discrepancy between the flow of a stream and the actual service it renders is not confined to the Arkansas; it is general. I have here a report of the State engineer of Utah giving the amount of water in the Weber river at Devil's Gate, Utah, for 1904. Now, the gauge station on Weber river has been kept at Devil's Gate for many years. That is in the gorge between Evanston and Ogden. That has been reported as the available water supply of Weber river. During the last two years—1903 and 1904—the State engineer's office has been measuring the diversions of water from that stream, in all the ditches taking water from that stream, as a preliminary to the determination of water rights, and this shows that while on August 13 the amount of water in the river at the gauging station was 136 cubic feet per second—for the year 1904—(objection by complainant), on that date the amount diverted for irrigation was 635 cubic feet per second. On August 20 there was 134 cubic feet per second in the river, and 545 cubic feet per second was diverted. On September 10 there was 136 cubic feet of water per second in the river and 422 were diverted. Now, of these on the first date given, 475 were diverted in the mountain valleys above and 200 cubic feet per second were diverted below the gauging station. There are no tributaries coming in below that point; so that the difference between the 136 cubic feet per second gauged and the 200 feet diverted was practically the seepage water coming back to the stream, either from the canals as they take it out one from the other or the seepage water diverted earlier in the season. Now, take the last of those figures given, September 10, where 136 feet was in the river, there was 274 feet on September 10 diverted above and 148 diverted below (1383, 1384).

"I have not made any investigations in regard to return or seepage waters in the Arkansas river, nor has there been any made by the diversion of which I am the head. I only know the conditions prevailing in the Arkansas valley in Colorado and Kansas as I have observed them casually. I think the conditions there are no different from what they are on other mountain streams in the arid region. (Objection by complainant.) The deductions which I have made from my investigations are that a large amount of return or seepage waters comes back to the stream after it has been applied to the land for irrigation purposes; and that condition prevails generally throughout the arid region" (1384, 1385).

On cross-examination by counsel for Kansas, witness stated:

That, as a general proposition, of the water diverted from the stream for irrigation, two-thirds is evaporated and absorbed by plant life (1390); that the probabilities are that the seepage waters may not flow down to the river just parallel to the tributary (1391); that irrigators living on the lower part of the stream desire the fullest possible diversion above during the period of abundance, because when you divert and apply an excessive quantity of water you not only increase the total quantity that comes back as seepage, but you increase the percentage of return seepage (1393), and so in irrigated districts everywhere the irrigators who live on the lower part of the stream welcome (1394) and encourage excessive diversions above when there is an abundance in the river; that the higher the degree of perfection to which irrigation is carried the less water there will be to run to the river, but that the irrigated area is increased. Thinks there is more water in the dry season of the year in the South Platte stream between the Colorado and Nebraska line and its confluence with the North Platte than there was before irrigation began on the South Platte. The irrigation around Greeley has decreased the flow of the South Platte between the Nebraska and Colorado line and the confluence of those rivers during flood seasons, say from April 1st to the last of June, but from some indefinite point between June and July it has materially increased it on until October (1395).

George H. Maxwell, Chairman of the Executive Committee of the National Irrigation Association (1163, 1168), on cross-examination by counsel for Kansas, said, in regard to seepage:

"The question of return seepage is always a relative one. Now, from my knowledge of the eastern slope of Colorado, I believe that in time an area of land could and would be brought under irrigation in eastern Colorado which would by evaporation and plant growth consume all the water which flows now across the State line into Kansas and Nebraska. In other words, my own judgment of it is that for a period of years the seepage would increase the flow of the stream, but eventually the area in Colorado would become so large that it would use all the return seepage, and the South Platte and the Arkansas would be dry streams from the Colorado line down."

On redirect examination by counsel for intervenor (1171) witness said that—

He does not know of any district in any foreign country where they have practiced irrigation for a period of years where they have overcome the question of return waters, and that in those countries where irrigation has been developed to a higher point than it has in this country they still have seepage or return waters.

Clarence T. Johnston, State Engineer for the State of Wyoming, on cross-examination by counsel for Colorado, said that (1028)—

It is difficult to say what percentage of water used in irrigation returns to the stream, as the normal conditions have not been reached anywhere; but that the return waters will undoubtedly increase from year to year, as this water has time to reach the natural channel.

Recross-examination by counsel for Kansas (1029):

"Undoubtedly the larger percentage of the water which is used for irrigation is lost through evaporation. * * * And it would be my judgment that it runs from 70 to 85 per cent."

Recross-examination by counsel for Colorado (1030):

"A large part of the water that is taken up by evaporation undoubtedly passes away and falls elsewhere as rain. It is not destroyed."

Nellis E. Corthell testified, in effect, among other things, on direct examination by counsel for intervenor (1037):

That he became familiar with the North Platte River in Nebraska beyond the junction in the early part of 1880. At that season of the year when the water should have been high there was very little in the stream; that in his judgment there is more water in the stream now in the summer time than when he first saw it. He attributes this increase to the taking out of the waters of the stream in the upper reaches for irrigation purposes. This saves the flood waters, which finally find their way back into the stream, thus increasing the flow during the dry season or the ordinary period of low water.

On cross-examination by counsel for Colorado (1041):

" * * * The amount of water used for irrigation on the tributaries of the Platte above that point has been very much increased since that time (1041). * * * The general rule is that the use of water for irrigation tends to equalize or level up the flow of water in the streams that I am familiar with" (1042).

J. A. Van Orsdel testified to the same effect as Mr. Corthell with respect to conditions along the Platte in Nebraska (1057–1058).

A. L. Fellows, District Engineer in connection with the Reclamation Service (1066) says, in effect:

That 25 to 35 per cent of the water used for irrigation returns to the stream, depending on locality, condition of soil, climate, etc.

Miguel A. Otero, Governor of New Mexico, on cross-examination by counsel for defendant, said, in effect (1078):

Irrigation tends to equalize the flow of the stream, as a great deal of the water returns as seepage.

Luther Foster, President of the Agricultural College of New Mexico, on cross-examination by counsel for Colorado (1084):

"I know from observation and experience that there is such a thing as return or seepage waters from irrigation. * * * The general rule is that it is from one-fourth to one-third." He says irrigation tends to maintain the flow of the stream at the later period when it would naturally be low.

M. W. Mills, on cross-examination by counsel for Colorado, said, in substance (1088):

Lands that are irrigated act as a system of reservoiring water.

Wendell M. Reid, of Roswell, N. M., District Engineer connected with the United States Reclamation Service, on cross-examination by counsel for Colorado, said, in effect, among other things (1117):

Have made a study of return or seepage waters from the irrigation of lands in the Pecos Valley in New Mexico. It is about twenty-five or thirty per cent here. Have no doubt that at other places on different soils it is greater. These return waters have a tendency to equalize the flow in the stream for irrigation purposes. Since the construction of large reservoirs on the Pecos River in New Mexico and the irrigation of lands in the Pecos Valley in New Mexico 90 miles above Pecos City, Texas, the flow, except at flood times, at Pecos City has increased materially—that is, during the dry season of the year (1117). The stream at Pecos City has never gone dry

since irrigation on the Pecos River in New Mexico began. There are two dams on the river in New Mexico, eleven miles apart. There are times when all the water of the river is taken out at the upper dam or reservoir. The rains in the valley of the Pecos are apt to be torrential, so this river at times has a very excessive amount of water in it, and at other times it has a very small amount. The storage of water and the irrigation of lands have a tendency to maintain the flow of the stream during the dry season and thus equalize the flow the year round (1118). I made an investigation of the waters of the Rio Grande from El Paso as far as the mouth of the San Juan River, the last tributary that enters above its mouth; also all the tributaries both on the Mexican and the American side in that distance (1120). My investigation developed the fact, especially on the Pecos, that the irrigation of lands along it and the Rio Grande tended to equalize the flow of the stream or make it a better available flow (1121).

William G. Hamilton, of Roswell, N. M., who had had extended experience in practical irrigation in the San Luis Valley in Colorado along the Rio Grande and in New Mexico along the Pecos, in regard to seepage or return waters, testified, in effect (1126, 1127):

That if all the water should be taken out of the Pecos River a few miles above Roswell it would have no effect upon the supply of water at Carlsbad, 75 miles below, and in this connection said: "We dammed the Pecos River twice and absolutely shut off all the water, and yet there is a larger supply below at the period of low water than there was previous to the dams being put in at the present time. * * * From my own observation I know that the flow of the river has increased at least 100 per cent at low water 15 miles below Carlsbad. * * * That water comes below the dam from seepage." He states (1129) that at a point 24 miles below the last reservoir on the Pecos there is now more than double the amount of water running in low-water periods, at the lowest time of the year, than there was before the reservoirs were erected and the irrigation of lands was commenced; that this is to be accounted for by seepage from the irrigated lands above, and that the amount of seepage water has increased every year. He states (1130) that the taking of the water from the Rio Grande in the San Luis Valley in Colorado when the river was high has increased the water in the low period through the canon near the New Mexico line at the time of the year when the stream was naturally low, along in July and August.

Francis G. Tracy, of Carlsbad, N. M., President of the Pecos Irrigation Company, testified in regard to seepage as follows:

"In a measure I believe the storage of water in reservoirs and the use of it in irrigation has a tendency to equalize the flow of the streams below (1135). * * * It takes several months for the return waters to reach the river, but eventually a portion of it gets back into the natural drainage channel and goes down the river" (1136).

Frank W. Mondell, of Newcastle, Wyo., member of Congress from that State and Chairman of the House Committee on Irrigation of Arid Lands, said (1186–1187):

"My experience with return or seepage water is based upon observation, and in some instances rather careful observation, but not at all upon measurements, and my observation has been that a very considerable amount of the waters used in irrigation are returned to the

streams, the amount depending, of course, on many factors—the amount of water used in irrigation per acre for a given unit, the character of the soil, the distance of the land irrigated from the stream, etc. Many things enter into the question of the amount of seepage, of course the most important of which is the amount of water originally put on the soil. But my personal observation is that a much larger percentage of the water used in irrigation returns to the stream than has generally been supposed by people who have knowledge of irrigation. It is undoubtedly true that whenever any considerable tract of land is irrigated for a period of years it will return a certain amount of seepage water. Whether it returns to the stream from which it is taken depends upon whether it is taken out of the drainage. But it will furnish a considerable amount of water. I have never seen any system of irrigation so perfect that a considerable tract of land could be irrigated for a period of years without furnishing seepage or return waters. I cannot conceive of a system that would not furnish some return waters. I think that the equalizing effect upon the flow of streams in my State of the irrigation of large tracts of land bordering on the stream is very decided. I have in mind as an illustration a small stream about four miles from my own town, which is Newcastle, Wyoming, a stream which I see very often. It is a stream known as Stockade Beaver Creek. I have known of the stream for eighteen years. I have never made any measurements of it, so that my statements with regard to its volumes are simply from observation and reflection, but when I first saw the stream eighteen years ago there were perhaps 250 or 300 acres of land—possibly 300 acres—irrigated from it. The acreage irrigated gradually increased until about ten years ago there began to be complaints of shortage of water, and at that time possibly there were 450 acres irrigated from the stream, and the general impression was that we had reached the limits of irrigation from that stream. The lower ranch which it irrigated was one of considerable size as ranches go. It had ten years ago perhaps 250 acres under irrigation and the stream below that lower ranch was always dry during the irrigation season. Irrigation has gone on until I imagine there are a thousand acres irrigated from the stream, including this lower ranch, which was supposed to be the limit. It is the lowest ranch down the stream which has a perpetual water right, but some six or seven years ago parties took up some lands below the lower ranch and applied for water rights for flood waters, such waters as are available. It is not, however, a flood stream in the usual acceptation of the word. It is a stream of a pretty steady flow. In the last three or four years some three or four hundred acres—or possibly not over three hundred and fifty acres—have been irrigated below the lower ranch—the 'L. A. K.' ranch—and the people owning those ranches contemplate considerable further extension of the irrigated area, and the water flow is sufficient to warrant them in their expectation of being able to increase their irrigated area very largely; so that that stream irrigates now and furnishes water, ordinarily, which will be used for irrigation in the near future for sixteen or seventeen hundred acres of land. Its original estimated capacity was considerably less than one-half of that—nearer one-third. The increased capacity is due partly to economy in use, but very largely to seepage and return waters. Some of those farms irrigate early and

late when the waters would not ordinarily be utilized at all otherwise. The stream is a perennial stream now ten miles farther down its course than it was eighteen years ago when there was less than one-fourth of the irrigation there is now. * * * I am led to believe that the use of water along the stream of irrigation tends to equalize the flow of the stream, reducing the maximum and increasing the minimum."

Fred T. Dubois, United States Senator from Idaho, states (1194-1195):

"My observation has taught me that the irrigation of large tracts of land within the watershed of a stream tends to equalize the flow of the stream farther down, making the maximum flow less and the minimum flow or dry time flow greater. * * * I should think that where streams were made practically dry by the subtraction of water for irrigation that farther down would show a good flow of water, this must, on account of physical conditions, be accounted for by the return or seepage waters from the lands irrigated."

Joseph M. Dixon, member of Congress from Montana, states (1200):

"My observation and experience with reference to the effect upon the supply or constancy of the supply of water in the stream by taking the water out and spreading it over the land is that it makes the stream more permanent and the flow more even, usually, lower down the stream. Of course of the smaller streams it practically dries them up where the irrigation is done, but it seeps back lower down the valley usually."

W. A. Reeder, of Logan, Phillips County, Kansas, member of Congress from that State and a member of the Committee on Irrigation of Arid Lands in the House of Representatives, says that (1217) in his judgment, based upon experience, if you make the soil thoroughly wet by irrigation at the head of the stream it is bound to be a more regular stream.

F. H. Newell, Chief Engineer of the Reclamation Service of the Geological Survey, on cross-examination by counsel for Colorado, states that (1281) his recollection is that there is a return seepage of from 25 to 30 per cent of the water applied. That his impression is that the return waters from the ditches which take water from the Arkansas River in Colorado reach the river in a fairly continuous seep throughout its length; that the full effects of the return flow from irrigation under a large system is not seen until years after the land has been put under irrigation; that some years must elapse necessarily for the water to saturate the soil.

Francis E. Warren, United States Senator from Wyoming, states (1292):

"* * * It is nearly impossible and imparcticable in taking the water out of any given stream, unless it is taken over a divide so that it goes into another stream bottom, to prevent some portion of it getting back to the stream lower down. In other words, we are never afraid but what we shall have enough in the stream for domestic purpose and the watering of stock and all of that below where there is plenty of irrigation (1292). * * * As a general proposition, the amount that gets back in seepage water increases with the amount of land under irrigation and the amount of water used to irrigate such lands" (1293).

W. H. Code, of Hollywood, Colo., Inspector of Irrigation under the Department of the Interior for the Indian reservations throughout the west, said, in effect (1322):

Have made some observations of the question of return waters in Arizona, but not extensively. There is a certain proportion of the water used for irrigation that gets back to the stream again. That this proportion is increased by the cultivation of lands for a series of years. From my observations in Arizona and other States I feel that this can be stated positively.

Joseph M. Carey, of Cheyenne, Wyo., ex-United States Senator (1330, 1331)—

Thinks that irrigation helps to level up the stream and maintain a regular flow. The amount that comes back as return water increases as time goes on and the lands become more thoroughly saturated.

Louis G. Carpenter, State Irrigation Engineer for Colorado, on direct examination by counsel for Colorado, stated, in effect, among other things:

My observation and experience have shown that where large tracts of land bordering on a stream have been brought under irrigation the seepage or return waters from such irrigated lands tends to increase as the years of irrigation increase. During the first few years there is very little seepage. The irrigation of large tracts of land has produced running streams in what had formerly been dry gulches. This is analogous to the springs of a more humid climate. The lower ground is saturated and this water percolates out very slowly, so that it forms a constant supply, and except for the difference due to temperature, which affects it, the streams which are supplied from that source are practically constant the year round (672). A great part of the flood flow is withdrawn from the river and applied to irrigated lands along its course in the State, which lands act as reservoirs. They store the excess water when so applied and that which comes back to the river comes back more gently and is scattered over a greater period of time, or at least a large portion of it does. The water that has been applied during the flood period in the summer comes back somewhat later, and this tends to produce greater uniformity in the flow of the stream, and a more constant supply to the stream (673). There is about 200 cubic feet to the second of return waters from the ditches along the Arkansas River in Colorado between Canon City and the State line (669, 673). This amount, judging from experience in other localities, is likely to increase. On the Poudre River in this State (Colorado) it has increased nearly fifty per cent during the last fifteen years, and more than that on the South Platte. The return water there is now about 1,000 feet per second (669).

Cross-examination by counsel for Kansas (763, 764):

From one-half to two-thirds of the amount of water used in irrigation is evaporated and goes into plant life, and one-third will find its way back into the stream (763). The water in the Arkansas River from Canon City to the Kansas State line is used over and over again as often as it can be used. The oftener it is used for irrigation the greater the proportion of the original amount that flowed down the river is lost to its general flow.

T. C. Henry, on direct examination by counsel for Colorado, in answer to preliminary questions, showed that he had a great deal of experience and possessed much practical knowledge in regard to irrigation (712):

"This seepage or return water has had the effect upon the Arkansas river in eastern Colorado and western Kansas of making a more permanent stream of it * * * (712). My particular observations of the Arkansas river began in 1888. At that time I began irrigation enterprises in the Arkansas valley in the State of Colorado. I am confident that there has been an increased flow during the winter months, and of course because of the return flow in the amount of water carried by that river across the border into Kansas" (713). He says that in the use of water for irrigation, taking into consideration a term of years thirty or forty per cent is lost by absorption and in plant life and the balance is returned to the stream (720).

Anthony Bott, of Colorado Springs, Colo., on direct examination by counsel for Colorado, testified in effect (819):

Have been acquainted with the Fountain Creek, a tributary of the Arkansas in Colorado, since 1858. Have farmed by irrigation. Irrigation from the Fountain has resulted in a more permanent flow of water in the stream than in the early days. The water that is used for irrigation will come out into the bed of the stream at some place (819). Springs started up along the stream after I commenced irrigating. When I stopped farming these streams dried up (820).

Henry McAllister, on direct examination by counsel for Colorado, in substance (822):

I knew the Fountain early in 1872. The flow of the water therein is larger during the summer season and particularly the late summer season now than it used to be before many of the ditches that are now flowing were created. The flow is more regular and comes from a number of sources that were not known at that time.

Cross-examination by counsel for Kansas:

Much more than half the water that is run on the ground in this part of the country for irrigation comes out again in the stream below.

T. B. Pyles and A. Z. Sheldon (827–831) corroborated the testimony of the two preceding witnesses with respect to return or seepage waters from along the Fountain.

John R. Sitlington, on direct examination by counsel for Colorado (835):

We contend that there is more water in the Fountain in the last few years than we had previous to that time. There is decidedly an increase in the amount of water in the creek.

Thomas Shidelar, on direct examination by counsel for Colorado (837):

There has been a good deal more water in the Fountain River during the last years than during the first. I noticed this increase soon after they got to irrigating here, in 1871. The flow did not increase for several years. From 1888 it has increased. This increase is due to return waters from irrigation.

Dall De Weese, of Canon City, Colo., on direct examination by counsel for Colorado, states that for twenty years he has been engaged in reclaiming land by irrigation (837). Testifies in effect that irri-

gation along a stream has the effect of equalizing the flow of the water in the stream and making it more uniform during the dry season, and gives specific instances within his own observation to sustain this conclusion (838–843).

John J. Thomas, on direct examination by counsel for Colorado (855), testifies that since the construction of the Bessemer ditch near Pueblo water now comes out from arroyos below the ditch that were formerly dry.

Oliver H. P. Baxter (858) testified to the same thing.

G. B. Schmidt, on direct examination by counsel for Colorado (870):

Live at Pueblo. Have had occasion to notice seepage or return waters along the Arkansas. It had increased from year to year. When I first came here about ten years ago very little of that water could be seen in any of the arroyos, but now since nearly all those lands are in cultivation the seepage has increased very largely. About three years ago we ascertained (871) that about 70 cubic feet per second of the water that was turned into the Bessemer ditch returned to the river.

H. M. Fosdick, of Rocky Ford, Colo., on direct examination by counsel for Colorado (889):

Have noticed the effect irrigation of lands above Rocky Ford has had on what were formerly dry arroyos that lead toward the river. I am now using 150 inches of water that is seepage water (889). The flow in the river has increased very much in many places since irrigation commenced. There is lots of water where there is none before (890).

On cross-examination he said:

"It takes a good while for water to seep through the land" (891).

The following witnesses also testified in effect that more or less of the water taken from the Arkansas River in Colorado and applied to the lands for irrigation purposes returned or seeped back to the river at distances more or less from the places where the waters were so applied: S. W. Cressy (894, 897); Humphrey Best (902–903); W. N. Randall (906–908); George W. Swink (913, 915, 918); Frank Kreybill (927–928); C. B. Thoman (940–941); Harry S. Crittenden (947–950), who resides at Coolidge, Kans., states (949) that at the State line between Kansas and Colorado the seepage has increased the flow of the Arkansas River; John J. Donohue (952); Paul Rich (955–957), who lives at Coolidge, Kans., says: "I have noticed the river carefully during the last two or three years, and there has been more water on an average, in the years 1902, 1903 and 1904 than for six or eight years previous thereto, at Coolidge;" James A. Baird, who says, in effect (957–958), that between Holly, Colo., and Coolidge, Kans., there has been a better flow in the river than previously, and about uniform during the summer months. See also William W. Jones (959–963); Amos Newton Parish (963–964); Marsena J. McMillin (971); A. E. Bent (974–977); and G. R. Hillyer (978).

W. M. Wiley, of Denver, Colo., representing the defendant, the Arkansas Valley Sugar Beet and Irrigated Land Company, states, in effect (1441), that irrigation and the storage of water in Colorado along the Arkansas River has steadily increased the flow of the river in Kansas by reason of the return or seepage waters.

(4) TESTIMONY IN RESPECT TO THE QUESTION AS TO THE POSSIBILITIES OF THE MAINTENANCE OF A SUSTAINED FLOW THROUGH THE CONTROL OF FLOOD WATERS.

In the opinion of the court overruling the demurrer of Colorado to the original bill of complaint it is indicated that proof should be made with respect to the above question.

In the cross-examination by counsel for intervenor of I. L. Diesen, of Garden City, Kans., a witness for complainant (574, 582), the witness stated that considerable flood waters pass down the river which, if impounded in reservoirs, could be used for purposes of irrigating a large body of land; that there were reservoir sites of small capacity in the State of Kansas between Garden City and the Colorado line.

James Craig, of Garden City, Kans., a witness for complainant, on cross-examination by counsel for defendant (597, 601), stated that large quantities of water run to waste each year in the Arkansas River under flood conditions; that he knew of one reservoir site suitable for storing the flood waters of the Arkansas River between Garden City and the Colorado State line; that this site would make a large reservoir; that if there are suitable reservoir sites in Colorado it would be of advantage to western Kansas if the flood waters of the river and its tributaries could be stored. On cross-examination by counsel for intervenor (604) witness said that if the flood waters of the Arkansas River which now go to waste could be stored the result would be an increase in the amount of the return waters, which would benefit the river below all the way down.

On cross-examination by counsel for intervenor of T. C. Henry, a witness for defendant (694, 716–717), he stated, in effect, that if the flood waters of the Arkansas River in Colorado could be impounded in reservoirs the amount of return or seepage waters would ultimately sustain a flow of 600 cubic feet of water per second of time at the point where the river enters the State of Kansas. On page 727 witness states that for a long distance of the valley and bordering the valley the topographical situation is such as to invite comparatively inexpensive reservoir construction.

On cross-examination by counsel for intervenor of Walter N. Houser, of Denver, Colo., a witness for Colorado (993, 997), he stated that he had been educated as a civil engineer and was familiar with the watershed of the Arkansas River; that there were a great many places in the watershed of the Arkansas River where reservoirs could be erected to catch the flood and other waters which now escape.

A. L. Fellows, a witness for intervenor, and at that time District Engineer of the United States Reclamation Service (1061, 1064–1065), stated that it would be advantageous to construct reservoirs generally throughout the mountains of Colorado for the purpose of storing flood waters; that one of these advantages would be the equalization of the flow of the streams upon which reservoirs were erected; that an extensive system of storage would result in equalizing the natural and normal flow of the stream. The construction of reservoirs will lessen the damage from flood.

J. J. Hagerman, of Roswell, N. M., a witness for intervenor, and who was president of irrigation companies which invested large sums of money in the Pecos Valley in New Mexico in irrigation

works (1147, 1151–1152), on cross-examination by counsel for Kansas, stated, among other things, the following:

"* * * If by proper storage reservoirs the water were held back in Colorado, stored up in the mountains, then it could be used in Colorado and a very large share of it would go down to Kansas so that irrigating could be done there on a considerable scale. You cannot store water in a flat country; it has to be stored in the foothills and places where nature has made reservoir sites that could be improved. If that water were allowed to run to waste it would go right away over Colorado and down past Kansas and no one would use it. Let me cite an instance: When we were building the big McMillan reservoir in the lower Pecos valley some people who owned an irrigation enterprise at Barstow, Texas, informed us that they would not allow us to store water in the reservoir because the water belonged to them, that they had the right to it and that they were an older concern than we were. We told them that the biggest floods in the Pecos valley came in the fall when they could not use the water anyway, and it was running to waste and they were short of water in the dry season, and that if we stored water in very large quantities in these big reservoirs and used it in the dry season when there were no rains a large share of it would go back to the river and there would be a good deal more water in the Pecos river at the time of year when they needed it the most than if the reservoirs were never built. Now, that proved to be a fact. I know that to be a fact. The president of that company, Mr. Barstow—I know him very well—has told me often that our reservoir system there was a godsend to them because they got water in the dry season when they needed it" (1152).

B. S. Rodey, Delegate to Congress from New Mexico (1156, 1160), on cross-examination by counsel for Colorado, stated that it was true that the construction of reservoirs in an up-stream State and the using of water in that State at times when there was excessive water would augment the flow of the stream in the down-stream State at the time when the water may be low.

Joseph M. Dixon, member of Congress from Montana (1202), on cross-examination by counsel for intervenor, stated:

"* * * The building of reservoirs tends to make the flow more continuous. I know one stream personally in the Bitter Root country where they have a reservoir at the head of it. I think it usually went dry in the early part of August. The building of the reservoir lets some of the water down practically in September now."

Louis G. Carpenter, State Engineer of Colorado (1838), says that every reservoir tends to control the flood waters and to maintain a sustained flow in the river below.

(5) EVIDENCE IN RESPECT TO THE SO-CALLED UNDERFLOW; ITS EXISTENCE; ITS EXTENT; ITS SOURCE; ITS CHARACTER—WHETHER PERCOLATING WATERS OR WATERS RUNNING IN A DEFINED UNDERGROUND CHANNEL; WHETHER LEVEL OF HAS BEEN LOWERED; EFFECT OF ON PRODUCTIVENESS OF SOIL IN RIVER VALLEY IN KANSAS; VOLUME OF WATER IN RIVER DURING RECENT YEARS AS COMPARED WITH FORMER YEARS; ALSO IN RESPECT TO THE NATURE AND CHARACTER OF THE RIVER AND THE RIVER VALLEY IN KANSAS AND COLORADO.

One of the grounds of complaint, and perhaps the chief one, as set forth in the original bill and in the amended bill is, in effect, that in

the State of Kansas within the valley of the river there exists a so-called underflow (64–65) which is fed by the waters in the main channel of the river and which at its normal stage supplies moisture to the roots of plants sufficient to raise crops in the absence of rainfall, but which underflow has been diminished and been lowered by reason of the diversion of the waters of the river for irrigation and other purposes in Colorado to such an extent that it now does not furnish sufficient moisture throughout said valley in Kansas to raise crops in the absence of rainfall.

In the opinion of the court overruling the demurrer to the original bill (44), it was stated that "proof should be made as to * * * whether what is described in the bill as the 'underflow' is a subterranean stream flowing in a known and defined channel, and not merely water percolating through the strata below."

(*a*) *Complainant's Witnesses.*

M. M. Murdock, on direct examination (251), says he has resided in Wichita since about 1871. Editor of Wichita Eagle. Has known the Arkansas River since 1860. In that year discovered by digging down in the valley for water that there was an underflow that went to the east to the river; that out of this discovery came his hobby, which he called "subirrigation," and that his paper was the first to advance such theory. At page 254 he says that there is an underflow of water from the base of the Rocky Mountains to the Mississippi River; that under Wichita there is a river a thousand feet deep—loose gravel and sand; that by underflow is meant water in the valley under the surface, within eight or ten feet; that it has a perceptible flow; that he discovered the underflow by digging a series of holes on different nights, and that on one night he sprinkled some bran on the water in the holes and on the next morning it was on the south side thereof; that the direction of the underflow is generally southeasterly; that during the flood of July 7, 1904, three of his cellars had four feet of water in them, and when the river went down the water went out; that this water did not come from the surface, but from the seepage; that when the river is full the water in the valley is much nearer the surface than when the water is low; that this subirrigation benefited the corn; that when they lost the water in the river the farmers on the bottom lands complained that their corn crops were not as strong as when they had more water.

On cross-examination by counsel for Colorado, among other things, he said, in effect:

The hole that I have spoken of in which I put the bran was somewhere between Dodge City, Kansas, and Bent's old fort in Colorado. The bran moved in the direction that the river was running—southeasterly. Didn't sink any holes any distance from the banks (256). The American Water Works Company furnishes the water for Wichita. That, outside of the minerals in it, this water is as pure as in any city in the United States, and it could not be seepage of the plains and as pure as that. This water is procured through pipes sunk in an island in the river thirty or forty feet beneath the surface and brought up by a suction pump. I think the water which

supplies the waterworks beneath this island comes from Colorado and not from drainage in Kansas. I don't think it draws its supply from the river (258). The valley at Wichita varies from five to twenty miles wide, and I incline to think that the valley for five miles in width is practically filled something like a thousand feet deep with water. Don't know how fast the water under the surface moves (259). That about fifteen or eighteen years ago he took up in his paper the subject of the underflow and the effect irrigation in Colorado had upon same and had kept "whacking" it along pretty nearly ever since in his newspaper, the Eagle. Could not say when he noticed that the river commenced falling off (260). That he contends that the surface of the ground water has fallen off by reason of the depletion in the river in Colorado. He had discovered this by sewers constructed in Wichita and by a sink that he dug in 1872–73. That formerly in digging a cellar the water would come in for three or four feet in depth; that he still has that place, and the cellar is deeper and the water does not come into it now. The cellar is about four feet underground now, and the former one is about three feet. That a year or two after he had dug the sink he cleared it out and had to go a good deal deeper to get water (1261). That there is not half as much water comes down the river now as there was twenty years ago (262). The face of the country has entirely changed since I first came to Wichita. At that time it was mostly unbroken prairie. It is now planted with groves and orchards. Two-thirds of the country is now under plow. The growing of timber and the increase of plowed lands has affected the climate. Rains do more good now than formerly. There has not been much change in the precipitation. The percentage of water from rainfall that now reaches the river is less than formerly. The Wichita Eagle has been the vehicle for keeping the subject of underflow or subirrigation before the people more than any other paper (263).

On cross-examination by counsel for the intervenor (266), witness, among other things, said that in 1860 he took a trip to the tributaries of the Arkansas River near Leadville and California Gulch. From Salida, Colorado, to Twin Lakes the banks of the Arkansas were heavily timbered. Twin Lakes is above Salida fifteen or sixteen miles and below California Gulch. It was very heavily timbered from Salida to Leadville on both sides. The last time he was on the river in Colorado was in September or October, 1903. The land at that time surrounding the stream was entirely denuded of its merchantable timber. The big trees were all gone. The effect of the cutting of timber from along the banks of the stream is that the rains are simply precipitated into the channel of the river much more rapidly than when there is timber, and the waters from the snows in the timber melt more slowly than where there is no timber.

Oliver Mulvey, a civil engineer by profession, and who had resided in Wichita from the spring of 1879 to the year 1900, upon direct examination, testified, among other things, in effect (267):

That he was city engineer of Wichita for five years; that the first sewerage system was constructed under his direction; the present bridge at Douglas avenue was constructed and completed in 1879; when built it had eight spans, 100 feet each. The first span was taken

out in 1888, the second span before 1900, and the third span after he left Wichita. (This to show that the river had narrowed.)

Counsel for complainant showed witness Exhibits A 1, A 2, and A 3, and in reply to certain questions, the answers of witness tended to show that from these exhibits it appeared that there was less water in the river now than formerly.

He further testified that the average flow of the river at Wichita during the dry seasons of the year for the last ten years has decreased in comparison with the average flow of the river within the first ten years that he knew it; that in digging ditches for sewers he came across the underflow in a number of places and that it was flowing in the general direction of south or southeast; that the water under Wichita has a decided flow southeast and extends in width some six miles; that sewers were commenced in 1888, and that in constructing them they experimented by boring a lot of test holes and went down to damp clay to find the height of the water; that his observation extended four or five miles up the river (268); that he doesn't know that the decrease in the flow of the river has any effect upon the underflow except to decrease the rapidity of the flow; that the decrease in the flow of the river has lowered the surface of the underflow; that he calls it a river underneath Wichita; and that this is a mere theory or belief or judgment (269).

On cross-examination by counsel for Colorado, witness, among other things, said, in effect:

At Wichita this underflow extends two miles on the east side of the river and four miles on the west side, and as far north as the sands exist beneath the surface. I don't think there is any underflow at Pueblo. There is a rock bottom there. In my judgment the water is supplied from the river itself, commencing east of Pueblo, Colorado. Undoubtedly a portion of this water comes from the general drainage of the country, independently of the river (269). I have made some investigations with respect to the velocity of the underflow. In my judgment, it has a velocity of one to two feet per minute, or from 60 to 120 feet per hour. If investigations should show that this underground water was moving at the rate of only nine or ten feet in twenty-four hours, that would not cause me to change my opinion in reference to its velocity. My investigations have been confined to Wichita and vicinity (270). I found the direction of the underflow in the open ditches. I have observed the Little Arkansas River. There has been a decrease in it, but not the same decrease as in the Arkansas River. The big stream is sometimes dry, but the little river I never saw dry. I am not positive whether the little river has decreased (272).

Cross-examination by counsel for intervenor:

I found the underflow on both sides of the river and underneath its bottom and above the level of the bottom of the river. You might find it above the level of the surface of the river when the same is rapidly falling (272).

On redirect examination by counsel for complainant, the witness stated:

"* * * The difference between underflow and sheet water is that sheet water may be standing still and an underflow would be flowing * * *."

John W. Harrison, who lived near Colwich, on the river, in Sedgwick County, of which Wichita is the county seat, since 1871, on direct examination testified in substance, among other things, as follows (273):

In this country there are three descriptions of land—first bottom, second bottom, and highlands. Have been acquainted with the Arkansas River for fifteen years. The average flow of the river during the dry season has decreased since the year 1885 from two to five feet. Subirrigation rises and falls with the flow of the river. When the river is comparatively dry we don't see but very little of subirrigation. It has a noticeable current from northwest to the southeast (273). Subirrigation has been reduced and the level of it has gone down from two to five feet. The lowering of the water in the river has been caused by the irrigation ditches in Colorado. I noticed the water began to go down immediately after those irrigation ditches were put in there. During the last ten years the average flow in the river has been comparatively dry (274). I have a cellar, and you put a light object in the cellar and leave it there overnight and in the morning it will be in the southeast corner. That shows there is a current in the underflow (275).

On cross-examination by counsel for Colorado, witness testified, among other things, in effect:

In sinking down on my lands I think we have to go from two to five feet deeper to strike the water level than we used to. We have to go pretty close to ten feet now. I first noticed the shortage in the river about twelve years ago (275). When my well was first dug it was ten feet to water; now the water stands from twelve to fifteen feet deep. That well is about a mile and a quarter from the river (276). The river where I live was a large stream originally, a thousand feet from bank to bank, and there were times when a thousand feet were covered with water (277).

Henry Jurgensen, who had been acquainted with the flow of the Arkansas River since 1878 near Mount Hope, Kans., testified in effect, on direct examination, among other things, as follows (279):

That the average flow of the Arkansas River during the dry season for the last ten years has been three or four feet lower than it was for the first ten years that he knew it; that the first time he ever saw the river dry was in 1887 or 1888 (279); that it was believed that the decrease in the flow was caused by taking the water out in Colorado; that the underflow has gone down proportionately with the river itself (280).

On cross-examination by counsel for Colorado, witness testified, among other things, in effect, as follows (280–281):

Had done nothing at his place to find the depth of the water under the first bottom; had dug several wells on the second bottom. The first well was dug down sixteen feet in the winter of 1879. Used it for five or six years and it went dry. Then made a drive well, about a mile from the river and a quarter of a mile from the first bottom. Went twenty feet for water. The second well was on higher ground than the first well. It went dry about 1886 or 1887. After that drove down a well pipe about 22 feet where the first well was dug. From 1879–1886 in order to get water had to go down six feet deeper. The last well has not given out. It is there to-day, and has not dropped since 1886 to the present time.

W. O. Huss, who had lived 3 miles east of Mount Hope since 1871, and owned a piece of first bottom land and was acquainted with the river, on direct examination testified, among other things, in effect (282):

That his land ran within several rods of the river; saw it nearly every day. The flow in the river during the dry season in the last ten years is not what it used to be before that time, but is from two to four feet lower than it used to be. The water has gone down in their ground where they dug. At his house it is now six or eight feet to water, and when he first went there he dug a hole in the ground and put a barrel in it, and the water in the barrel rose and fell with the river. The water level throughout the year rises and falls with the river.

On cross-examination by counsel for Colorado, witness stated, in effect, among other things (283):

The barrel I put in to get water was a little over half a mile from the bank of the river. I think the place was higher than the bank of the stream. There is a slough there which runs into the country back of the river and collects the drainage water back southwest (283). There is only water in the slough when it rains (284).

C. E. Tupper, of Mount Hope, Kans., who had lived five miles east and one mile south of there since 1880 and a mile south and a mile east since 1881, and who had owned and cultivated first bottom lands along the river since 1881, on direct examination testified, among other things, in effect, as follows (284):

That the average flow of the river for the last ten years had been less than for the first ten years that he knew it during the dry season. That the underflow was not as near the surface as it used to be thirty years ago. That it has gone down proportionately with the level of the flow in the river (284). When the river raised, the water raised underground. When they had an open well, they could tell how the river raised by the water rising in the well (285).

On cross-examination by counsel for Colorado, witness testified, among other things, in effect (285):

Mount Hope is two miles from the river, on the second bottom. I put my first well down in 1871 and abandoned it in 1876. I found water at about eight feet. In 1880 I sunk a well and found water at seven feet, I think. This was about a mile from my first well and about three-quarters of a mile from the river. The water level often rises and falls, but I don't know how much. I know this because I saw it in the well during the first few years, but the later years I didn't pay much attention because the river has been so low (285). I don't know whether the water level under the first bottom along the Arkansas River in the section where I live has fallen below its level of a few years ago. I do know that it is up and down. It goes up and down with the river (286).

On redirect examination (286) witness states that in his opinion the water level has gone down in the bottom lands, but would not swear to it.

H. H. Hansen, on direct examination, said in effect, among other things:

That he had been familiar with the river between Wichita and Hutchinson since 1870 and had occupied 160 acres of land on the first bottom (286); that during the last twelve or fifteen years, during

dry season, they had no river between the mouth of the Little Arkansas north; that when he first went into that country he dug a well and found that the sand would bank up in the northwest corner of the well, and that indicated to him that the water came over there and pushed the quicksand up; that by digging three or four feet he could get plenty of water; noticed a difference in the level of the water in excavations; that the water rose and fell in the holes when the river rose and fell (287); that now they have to go three or four feet deeper to strike water than in the seventies; that the effect of the underflow in his judgment extends throughout the whole bottom and the change described has extended over the whole bottom (288).

On cross-examination by counsel for Colorado (289–291), witness said, among other things, in effect:

That the water always came from the northwest—the underflow; that as they dug the water didn't come in from all sides. Had never noticed a rise or fall in the wells independently of the rise and fall of the water in the river.

D. E. Breese, who had lived in Sedgwick County, Kans., for twenty-six years, 18 miles northwest of Wichita, and had owned land adjacent to the river during that time, on direct examination, said, in effect:

That formerly there was a flow of water several feet deep in the river from bank to bank during the growing season—July, August, and September, and on through the fall—but now they had practically no river at all; that this latter condition had existed about twelve or fourteen years; that when the river rises the water rises under his farm; that he knows this by the digging of forty or fifty wells in the neighborhood, and that he could tell the condition of the river by looking at the wells; as the river would fall the water would go down in the wells (293, 294); that by observing the water in the wells he saw that without any exception the water would clear on the upside of the stream first, indicating that the current was to the southeast, corresponding to the direction in which the river flowed; and that the underflow has gone down, and he attributes this to the lack of water in the river (295).

On cross-examination by counsel for Colorado (296), witness said, among other things, in effect:

That the river has been decreasing since 1891; that he doesn't know what has caused this, but attributes it to the taking of water out of the river.

G. M. Shive, who had lived in Burrton, Harvey County, Kans., since 1885, and prior to that time had lived two miles southwest of Burrton since April, 1874, on direct examination stated, in effect (300):

That he was acquainted with the average flow of the river in the early years; that during the dry season of those years, the first ten after he had settled on the land, the average flow of the river was not more than from one to two feet; that for the corresponding time during the last ten years it has been fully less than one-third in height; that there is an underflow which extends as far from the river as Burrton; that at Burrton the Santa Fe has a large well; that the water in that well does not stand up so near the surface as it used

to, being six or eight feet lower; that the underflow rises and falls with the river; and that there is a current in the underflow to the southeast.

Silas Rutledge, who had lived in Sedgwick County from January, 1871, until 1902, and who had owned bottom land within 40 rods of the river on the south or west side, on direct examination testified, among other things, in effect, as follows (302):

That the average flow of the river has decreased since 1888; that there is an underflow—observed this by digging a well; that the water rose in the well with the rise and fall of the river, and that during the last ten or fifteen years the level of the underflow has gone down from three to four feet.

Charles E. McAdams, on direct examination testified, among other things, in effect, as follows (305):

That he is a physician; that he had lived and practiced his profession in Wichita since 1873 continuously. In early years had given attention to experiments made by the board of health of the city concerning the waterworks; was on the health committee appointed by the city; had made experiments concerning the underflow of the river through the city about 1882; that they drove wells in different parts of the city to different depths and took samples from different depths for analytical examination (305). Found water anywhere within four feet, oftentimes less than that, but it was not fit to use. Performed some experiments on the lot on which the Federal building stands in Wichita; thinks this was in 1882; had no waterworks then; drove five wells on this lot; four of them were at the corners of a 20-foot square, the fifth in the center; they were all driven 16 feet deep. The men pumped the water out of them all so that the water was clear; that he unscrewed the stop from the middle well and suspended one-half ounce of red aniline in a cheesecloth in such a way that it would sink properly; had a man at each of the four pumps; noted the time when the aniline was suspended; that the pumps pumped just alike; the red aniline appeared at the southeast pump first; it took a minute and a quarter before it reached there; it appeared next in the southwestern pump, about a half minute after it appeared at the first pump; it next appeared at the northeastern pump; the northwest pump did not show any red water; the pumps were kept going at the same rapidity for two hours; that this experiment showed that the water flowed from the northwest to the southeast about 35 degrees; and that the greatest amount of red water was at the southeast pump (306).

On cross-examination (307) by counsel for Colorado, witness said, in effect, among other things:

That the wells were four blocks east of the river; that water could be found at a depth of nine feet. The river runs directly west of where the wells were sunk. The pumps were working half an hour before the coloring matter was put in. They were not pumping the same all the while, possibly. Doesn't think the men all worked with equal rapidity. The pumps were the same. The men were different in physical size and strength. Thinks the coloring matter went to the pumps from the subterranean flow. Thought (308) there was a well-established current or underflow in the direction from the northwest to the southeast in the sands. Based this upon the experiment referred to.

John W. Shive, on direct examination, testified, among other things, in effect (309):

That he had lived near Burrton, in Harvey County, Kansas, since June, 1871, and owned a quarter section of land there. Was acquainted with the Arkansas Valley from Wichita to Lakin, Kearney County. It was about fifteen miles wide where he lived; at Hutchinson, Sterling, and Great Bend, about eight; not quite so wide at Dodge; about six or eight at Garden City, and at Lakin about five or six miles (309). The city of Burrton is eight miles from the river; that the average depth of the flow of the river during the dry season of the year, excluding May, June, and July, for the first fifteen years that he knew it, was from two to two and a half feet; that for the last ten years during the dry season, excluding the three months mentioned, it was not so great; sometimes there is no flow at all for about one-tenth of the year, and during the balance of the year outside of the months named the average flow is not more than six inches (310); that there is an underflow under the whole valley which runs parallel or nearly so with the river; knows this from information and from experience in digging surface wells; that it is now about three and a half feet farther to water than it used to be; that the current of the underflow is nearly parallel with the river; that the water in the well as far back as Burrton rises and falls with the rise and fall of the river (311).

On cross-examination by counsel for Colorado, witness stated, in effect, among other things, as follows (316):

That he sunk the last well two years ago at his place so that he could test it; that he has sunk wells since; that he had to go three feet deeper for water than in earlier years. Believes there is a current in the underground waters from the fact that water in well would clear from the northwest side and go towards the southeast; that the underflow evidently comes farther west and flows some distance underground; thinks it comes from as far west as Colorado; and that the wells in which he observed the rise and fall of the water are four miles from the river.

R. E. Lawrence, of Wichita, Kans., whose testimony begins on 318 and ends at page 334; B. H. Campbell, whose testimony begins at page 334 and ends at 339; C. P. Fullington, of Wichita, whose testimony begins at 340 and ends at page 344, and D. A. McCandless, of Wichita, whose testimony begins at page 344 and ends at page 351, each testified, in effect, that he had known the river for several years, was acquainted with its surface flow; that the same had decreased perceptibly in recent years; that there was an underflow with a current running in the direction of the river; that this was shown by observing water in wells sunk in the valley; that the water in the wells rose and fell with the rise and fall of the water in the river; that it cleared from the northwest side, and that the level of the underflow had gone down from two to four feet.

Hiram W. Lewis, of Wichita, Kans. (351), engaged in banking and loan business, and who had lived in Wichita since 1866, testified, among other things, that for the last ten years there has not been as much water in the river as during the ten years previous.

A. B. Caldwell, of Wichita, Kans. (353), who had lived in Reno County for thirty-three years and who first saw the river in the

spring of 1850, at Great Bend, testified, in effect, among other things, as follows (356):

That during the last few years there wasn't nearly the volume of water during the season that there was in the earlier years; that the diminution began in 1885; has been nearly stationary the last few years; not much change during the last seven or eight years. Unquestionably there is an underflow in the valley from the percolating water from the river out through the soil at either side. He has seen it tested by digging holes a mile or two away from the river. If light material was dropped in the hole it would float across the top to the opposite side. The current of the underflow was away from the river (356). Had observed changes in the height of the underflow in the last few years. There had been a change in the height of the water in the wells of from two to six feet; and has to drive wells now on an average of three feet deeper to get water (357).

Cross-examination by counsel for Colorado (359):

Have a notion that there is an underflow under the second bottom at places. Never ran any levels to ascertain the level of the water. The water came into the wells nearly parallel with the river, but not entirely (359). The reason he wanted to know was that they were proving they had an overflow in the Arkansas valley. They were advertising they had an underflow. This theory is generally accepted now (360). Understands that the underground water is supplied by the river (361).

Redirect examination (363):

"The underflow regularly follows the rise and fall of the river."

A number of witnesses were examined by complainant in chief at Arkansas City in respect to the same subject, among them being R. A. Patton (364–367); P. H. Franey (367–375); Johnson Keller (375–381); John Myrtle (381–382); James Benedict (396–401); and R. J. Stevenson (401–404), and as typical of the evidence by each that of P. H. Franey is selected and is substantially as follows (369):

That the flow of the river at Arkansas City is not as large now as compared with the flow therein prior to 1885; and that the water level under the surface has gone down several feet lower than it was in the early eighties.

At Kinsley, Kansas.

R. E. Edwards, direct examination (424):

Has lived in Kinsley, Kansas, 29 years; owns 10,000 acres, and his home is in the adjoining county. Is acquainted with the Arkansas valley in Kansas. Kinsley is about a mile and a half from the river, on the north side. The valley in Edwards county averages six miles wide. The river flows through the county to the northeast to Great Bend (424). During the early years that he was at Kinsley the width of the river was about a thousand feet wide, and the water extended from bank to bank about two feet deep. During the last ten years the river has been dry a great deal of the time (425). Thinks the diminution in the water is caused by irrigation in Colorado. Thinks it began in 1883. During the early years would strike water almost at the depth of four feet on the first bottom lands; sometimes two and one-half feet. Can strike water now at from eight to eighteen feet on the first and second bottoms. The water on the first bottom lands rises and falls with the rise and fall of the river. Thinks there is a substantial and visible current in the water underlying the

first bottom and that it flows in the same direction as the river. At page 425 he said the land next the river is called "first bottom," and when they go back a varying distance from the river there is a rise of perhaps six inches to two feet and this they call "second bottom." As they go further back there is a gradual rise that they frequently call the "second bottom and upland" (426).

Cross-examination by counsel for Colorado (429):

That when he first went to Kinsley the water in the river was approximately from eighteen inches to two feet deep; that the water under the soil came within eighteen inches or two feet of the surface; that it continued to hold that level until 1885 or 1890, or along there; that now they can strike water within ten to fifteen feet of the surface in the bottom lands anywhere (429). Within twenty rods of the river water might be found at a depth of five feet. If a hole is sunk a half a mile away from the river, the water will rise and fall in the hole with the rise and fall of the river; that it will rise in the hole to the level of the river; that his idea is that there is a certain amount of water running underneath the soil all the time; that when the water in the river is high, water will be found quicker than when it is lower; that as a general thing, have to go deeper now for water than formerly; doesn't know that the underground water comes from the river alone; thinks that when all the water is taken out of the river it diminishes the supply of the water under the soil, and that a great deal of the water under the soil came from the same source that supplies the water of the river. Observed that the underground water has a fixed current. Dug hole on the river bottom and the water seemed to come from the upper side and flow across. When a hole is sunk the water comes from all directions. Thinks the water which is found in the bottom lands is usually percolating through the soil (430). Doesn't believe the underflow extends back from the upland. Thinks the water level is higher as you go back from the river. If water should be found in the town of Kinsley a foot higher than the water level in the river, he would still believe that the water level was influenced by the river. Doesn't think the flow of water in the river is much affected by the water that falls on the ground in this part of Kansas (432).

Floyd E. Wellman, direct examination (435–436):

That he had occasion to notice the underflow, particularly on the north side of the river in the town of Kinsley, and that there is some current to it; that the underflow is not as close to the surface as it was in 1885; it is about two feet lower.

William H. Vernon, direct examination (441):

Has resided at Larned, Kansas, since 1875. The flow in the river began to diminish in the late eighties.

At Dodge City, Kansas.

Robert N. Wright, direct examination (444):

Helped to lay out Dodge City in 1872; first came up the Arkansas in 1859; was along the river a great deal from that time to 1855. Has lived practically on the river since 1859. Has been farming on the river bottom near Dodge City and was commissioner of forestry for Kansas. The bottom lands at Dodge are about a mile wide. There are two bottoms; the second extends to the foot of the hills. Above that is upland. Second bottoms rise gradually from the first

bottoms and are not a great many feet higher. During the first twenty-five years that he knew the river the average flow, excluding floods and freshets, was about two feet deep and 200 yards wide. The average flow of the river during the last ten or twelve years, excluding flood and freshet seasons, was not half as great. One-quarter of the time during the summer the river is dry now (444). There is an underflow; it extends as far back as the bottoms extend. The underflow rises and falls with the flow in the river. Thinks it has a slight current in the direction of the flow of the river. The diminution in the flow of the river and the lowering of the underflow became noticeable about fifteen years ago. It was gradual (445).

Cross-examination by counsel for Colorado (446):

First saw the river in 1859 near Great Bend, where Ellinwood now is. That year the river got pretty low in September. In the early years the river went dry every three or four years in September; don't think it went entirely dry in 1859, but don't know. For a short time in the fall it was pretty near dry, so that it only ran from one puddle or hole to another in small channels and once in every three or four years it went almost entirely dry in the early years (446). In 1859 went up the river as far as Pueblo; went down in September from Pueblo; river was dry in places then. There wasn't a great deal of water in the river. In going up, the river was full all the way. There was a great difference in the river in going up and in coming down. First saw crops irrigated in Colorado in 1862 or 1863. Went as high up as Leadville, Colorado, in 1863. There was a great deal of heavy timber in the gulches in those days (447). Sometimes almost every year the river goes dry at this point, but most of the season there is some water running in it. In the fall of 1863 or 1864 the river was dry. In 1874, the grasshopper year, the river may have been dry during part of the season for about 100 or 150 miles, including Dodge City (448). There were some other years about that time when the river was dry for long stretches, but not many (449). Bases judgment that there is an underflow by observing water moving in open cuts and ditches (452). Testified before the Senate committee in 1859 that there was a well near Dodge City three or four hundred feet from the river, and adds that the water in the well is three or four feet higher than the water in the river. Within three or four hundred feet of the river the water level can be found three or four feet higher than the water in the river, and thinks it comes from the underflow. Believes the underflow comes from the entire drainage of the river, and that it percolates through the sand and gravel.

C. M. Beeson, direct examination (457):

Has lived in Dodge City since 1875; farmer and stockman. Acquainted with the river in western Kansas; knows something about it up to the mountains. The valley of the Arkansas through Ford county is three or four miles from bluff to bluff. It narrows as you proceed up the river. During the first fifteen years that he knew the river, its average flow, including floods and freshets, was about three or four feet deep. During the last ten years, excluding 1904, the river has fallen off one-half. There were seasons when it was practically dry. Acquainted with the underflow (457). It extends back for a mile or two miles very perceptibly to the foothills. It

flows in the general direction of the river and parallel with it. In 1884 placed water-closet in the basement of building. Dug down to quicksand and for years the underflow carried off the offal. Of late years it didn't do it for the reason that the water sunk away. When we first built cesspools water would stand two or three feet in them. In wells on the south side of the river water is at least three feet lower than it was eighteen years ago. When the river rises and falls the water in the wells rises and falls also (458). Has noticed in digging a water hole that the water would clear from the upper side while the lower side would be mucky and dirty (460).

Cross-examination by counsel for Colorado (461):

In speaking of the valley as being three or four miles wide, includes second as well as first bottom. Second is eight or ten feet above the first. When first came to the country could strike water any place two or three feet. During last ten years has had to go from four to six feet on first bottom to strike water (461). In speaking of the underflow on examination in chief, meant to say that the water north of the river seemed to flow towards it; that if it was south it seemed to flow from it more. Would not say that the water on the north side of the river was moving south toward the river and east with it, but thinks it is deeper to the underflow on the north side than on the south. Thinks the underflow comes from a higher point and from the west, but it is not certain (463).

Other witnesses were examined by complainant at Dodge City with respect to the decrease in the water in the river and the lowering of the level of the underflow, among them H. B. Bell (472–475), S. Gallagher, jr. (475–479), H. D. Chambliss (479–482), George C. Laird (484–486), and George W. Reighard (486–490); but none of them added anything to the testimony of witnesses Wright and Beeson.

At Garden City, Kansas.

F. L. Pierce, direct examination (542):

Has lived at Lakin, Kansas, which is 23 miles west of Garden City, since April, 1879. The flow of the river began to fall off about 1890. It has gradually diminished since. The level of the water in the wells has gone down along the bottoms. Has to go deeper for water than formerly. Built fence round farm in Kearney County in 1881 and struck water in almost every post hole. This spring (1904) was repairing fence and struck water at only three different places in digging post holes.

Jacob B. Stillwagon, direct examination (549):

Lives 12 miles west of Garden City. Has lived there about twenty years. Owns 160 acres of land one mile from the river, on the north side, one hundred acres of which is bottom land (549). During the first ten years he knew the river its bed would be from one-half full to full, and sometimes out of its bank through the summer time. During the last few years, with the exception of 1904, the water has been generally very shallow. Last year, 1903, the river was dry about nine months. From August, 1903, to May, 1904, the river was dry. The water level of the underground water is two feet lower than it used to be. Has observed current to the underflow (550).

George H. Reeve, of Garden City, a farmer by occupation, and who had resided in Finney County, of which Garden City is the county

seat, since October, 1880, testified in regard to the decrease in the volume of the water in the river and the lowering of the water level of the underflow to the same effect as the two former witnesses (554–560).

A number of witnesses were examined by complainant at Garden City in respect to the decrease in the volume of the water in the river during recent years and in respect to the lowering of the level of the subsurface water in the valley and in respect to such subsurface water having a current, etc. (569, 616), but as such evidence is merely cumulative on these points it is not deemed necessary to repeat it.

Counsel for complainant, in cross-examining certain of Colorado's witnesses who were placed upon the stand to testify in respect to the volume of water in the river in Kansas during recent years, elicited from them testimony tending to show that the water in wells in the valley of the Arkansas River in Kansas rose and fell with the rise and fall of the water in the river and that the level of the underground water in said valley had somewhat lowered since 1885. (See testimony of Dan Larmor (1463–1464), R. W. Evans (1508–1509), John D. Sidlow (1514–1515), H. Juneau (1540), T. G. Payne (1553–1554), A. A. Thorp (1579), George N. Moses (1584), W. B. Norris (1588), Frank Gibson (1590–1591), John Rogers (1599), E. E. Epperson (1601–1602), John F. Lewis (1605), F. D. Wilson (1611), L. P. Hadley (1628–1629), George Foster (1632), W. B. Jewell (1637), A. N. Culberson (1641–1642), W. F. Stevens (1647), J. R. Foster (1654–1655), J. R. Brown (1664); Joshua Rush (1701), Simon H. Loughlin (1722), Oscar L. Winters (1737), L. B. Dotson (1751), A. J. Shore (1759), A. D. Pennington (1801), T. C. Price (1804).)

(*b*) *Defendant's Witnesses.*

At Denver, Colorado:

Louis G. Carpenter, of Denver, Colorado, on direct examination (617):

Been State Engineer of Colorado since 1903; forty-three years of age; was professor in the State Agricultural College of Colorado; graduated at the Michigan Agricultural College in 1875; took postgraduate work in the University of Michigan and Johns Hopkins University—studies have been along the line of applied mathematics, physics, etc.; before coming to Colorado became interested in irrigation; at the Agricultural College in Colorado was given the chair in regard to irrigation; gave the first instruction in irrigation engineering that was given in the United States; was also appointed engineer of the Agricultural Experiment Station at Fort Collins, Colorado, which is organized under an act of Congress passed in 1888. The Government appropriates $15,000 annually for the experiment station at Fort Collins, which is used in agricultural experimentation, of which irrigation work is one of the lines (619). The approximate drainage area of the Arkansas River in Colorado is 26,000 square miles, and in Kansas about 20,000 square miles, excluding the portions of the Grand and Cimarron, which enter the Arkansas River below the Arkansas State line (620). One of the characteristics of the Arkansas River is that the upper reaches of the stream have constantly running water. Then it runs on the plains

in a broad, sandy bed, and the stream then tends to disappear. This characteristic is commonly true of streams along the mountains (625). The Platte is of the same character, and also the Rio Grande (626). The Arkansas River might appropriately be called two rivers or a broken river, the upper end a running river and the lower end a running river, and between these two living streams there is a portion which has been dry immemorially from time to time. In the absence of irrigation the upper river would begin to dwindle at its exit from the mountains. Irrigation modifies this tendency to some extent by the return waters coming in from springs. Without irrigation the Arkansas River would have a tendency to disappear and become dry between Lamar, Colorado, and Great Bend, Kansas, a distance of about 275 miles. Local conditions might put more or less water along this stretch in the river at times. The bed of the river from Canon City up is of a mountainous character. From Pueblo east it takes the character of a sandy bed most of the way, that is, sand and gravel, the sand becoming finer as you go farther east. The river increases in width from Canon City or Pueblo to about Coolidge, Kansas, and from Coolidge a distance of fifty or a hundred miles the bed from bank to bank remains at about a thousand feet. From there on to Arkansas City there is a tendency for the river to narrow up. The banks all the way through Kansas are three or four feet high, also through Colorado below Pueblo. Through Kansas the bed of the river is made up of sand of great depth; how deep we do not know (626–627).

"Throughout Kansas and along the Arkansas river and through part of Colorado we have long stretches of sand hills, sometimes becoming sand dunes. These prevail more on the south side of the river and often form a stretch of sand varying in width from two or three to a dozen miles. It consists of a fine sand that has been blown up and sometimes forms hills of considerable height. These hills are nearly always confined to the south side of the river. It is through these sand reaches from the Kansas-Colorado line to below Great Bend, Kansas, that great losses occur in the flow of the water in the river.

"The Arkansas river differs from lowland streams, those found in the humid regions, such as the Eastern States, in that its additions or its increase of supply from the country that it covers or goes through is relatively small. It has relatively few springs through a great part of its course from Pueblo down to about Great Bend, while a lowland stream, or such as typify the eastern streams, is one constantly increasing in size as it goes. Such a stream has a great number of springs and a great number of tributaries which are simply a collection or a series of streams; and then in the bed itself and along the banks it has constant accretions. That is not the case with the plains stream. Instead of increasing as the eastern streams do these streams of which the Arkansas river is a type become less in passing through this nonsupplying country. The country is one of low rainfall, and hence very little water runs in in that way. After you have passed down the Arkansas river until you have reached Hutchinson, in Reno county, Kansas, a tributary enters which is practically the first tributary since leaving the mountains that is perennial. That is Cow creek. At Wichita on the north side comes

in the Little Arkansas river and Chisholm creek; on the south the Ninnescah; and from there on are tributaries all along. From Hutchinson back to Salida, Colorado, there is practically no perennial tributary. I think Walnut creek at Great Bend could scarcely be put in that class, though it may run some water nearly all the year. From Hutchinson down, the river assumes a new character and partakes more of the character of the ordinary streams as known in the Eastern and Middle States" (627).

Made measurements and investigations which show that the river loses water between the Colorado State line and Great Bend and farther down. Such measurements were made during the past few years at various places, and records kept of them (628). In August, 1904, a flood was reported at Coolidge, Kansas. The water arrived at Garden City, Kansas, within fifteen minutes of the time we had predicted the day before. The distance between the two places is about 72 miles. This flood traveled at the rate of about two or three miles an hour. In Kansas the ordinary flow of the river is perhaps about two feet per second, and the fall varies from about four to seven feet per mile. Referring to the loss of water by the river, the river very rapidly decreases in its flow in the quantity of water, that taking a given quantity of water at any of the places in western Kansas, that quantity very rapidly decreases, as has been shown by numerous measurements and by recent floods (629). A flood reached the maximum of 10,000 second-feet at Coolidge on the afternoon of May 3rd. On May 5th it reached Garden City and was then but 8,000 second-feet, and at Dodge City it was but 3,000 second-feet; at Kinsley, 1,700 second-feet, and at Great Bend, about 2,000 second-feet; at Hutchinson, slightly over a thousand second-feet was the highest amount (630). The following are the widths of the river at the points named, in effect: At Canon City, 100; at Pueblo, 154; at La Junta, 420 (631); at Coolidge, 1,484; at Syracuse, 780; at Garden City, 980; at Dodge City, 550; at Kinsley, 920; at Larned, 500; at Great Bend, 700; at Hutchinson, 1,020; at Wichita, 500, and at the Madison Avenue Bridge, Arkansas City, 480 (631).

The witness further states, in effect:

In studying the Arkansas River and its history, I have taken occasion to examine all of the historical works bearing upon the stream that I have access to in the State Library at Colorado and elsewhere (632). Some of the writers refer to the river as being practically dry where they struck it on the Santa Fe trail, which is near where Great Bend now is. The early travelers and explorers have spoken of the river as being practically dry at the times and places they saw it in Kansas, which, as a rule, was above Great Bend, and have spoken of it as having the same characteristics as other plains streams (633), one of which is that they run on the plains in a broad, sandy bed, and then disappear (625). Among these travelers and explorers were Zebulon Pike, who explored the river in 1806, and whose journal supports the above statement. "The Oregon Trail," by Francis Parkman, who crossed the plains in 1846, describes the river at the point where Lamar, Colorado, now is, and says that for several hundred miles below it "is in August nothing but a broad bed over which glide a few scanty threads of water now extending into wide shallows" (635). Witness also referred to the

writings of Louis H. Garrard, in which the author gives an account of the condition of the Arkansas River on October 13, 1846, at Pawnee Rock, below Larned, to the effect that the river at that point was about two feet deep. On October 23rd of the same year, found the river at the Cimarron crossing but a few inches in depth. (Other citations were incorporated in witness's testimony from reports on file in the War Department, from the writings of Edward Everett Hale and others to show that long before any settlement in either Kansas or Colorado along the Arkansas River, the river from Great Bend westward frequently went dry during the summer season) (636–640, 642, 644).

The average flow of the river at Canon City is 750 cubic feet per second of time, including high and low water. From Canon City to Lamar the river gains by springs or seepage which comes from irrigation. From Coolidge eastward the river loses nearly constantly. In 1902 I measured the flood at Dodge City, and the river carried 5,701 cubic feet; at Hutchinson it had but 2,500 cubic feet; at Wichita 2,010, and at Arkanas City 1,193. In one flood there was a decrease of 41 per cent between Coolidge and Garden City. In another flood the decrease between these points was 49 per cent. The distance is about sixty miles. From the data which I have should judge that of the water which would pass Canon City or Lamar not over 30 per cent of it would reach Wichita, Kansas (644). In other words, if you had a certain amount of water at Lamar or Coolidge, not over 30 per cent of that would reach Wichita, even with the addition of springs which might be along the course, the invisible sources, but it does not include streams like the Walnut and Cow Creek. Assuming that the average flow of the river at Canon City is 750 cubic feet per second of time and that only 30 per cent of that amount would reach Wichita, and assuming that the river at Wichita is 500 feet wide, such amount of water would raise the river at Wichita not more than two inches, and if the river were a thousand feet wide at Wichita, as many witnesses said it formerly was, then this amount of water would raise the stream at that point only about half as much, or one inch (645). The river leaves the mountains at a little less than 6,000 feet elevation. Between the elevation of about 7,000 feet and 11,500 feet the large percentage of the area was originally forested. The amount of timber has since decreased materially; throughout the headwaters the effect of the ax and of the fire is seen upon every hand. A great deal has been cut for mining purposes, thus swallowing up the forests to a great extent; but the fires have caused even greater damage. From the best information I could obtain, it would seem that there is not over twenty per cent of the original forest now remaining, and that which remains is largely small timber (646). The influence of the forest was to catch snow. It was noticed that a rainy day in the mountains had the effect of decreasing the stream instead of increasing it—that is, an ordinary rainy day. The reason, as developed, is that the protection afforded by the clouds from the heat of the sun and the consequent decrease in melting decreased the water supply from that source, so that the decrease was greater than the increase of water supply from the rain. The forest has the same effect as the cloudy day. The burning of the forests has had a great effect upon our

water supply and upon its character (647). The forest protects the snow from the wind; the protection from the snow prevents the snow from melting; the protection from the wind protects it from evaporation. Hence the protective influence of the forest in preventing excessive wind is a very important factor in preserving our water supply. The protection from the sun would only change the character of the flow—that is, as to whether there were floods or not. The excessive wind would mean an actual loss of water supply. The eating off and the tramping down of the grass by cattle has also had an effect on the water supply, as the grass formerly was long and held the snow and protected it from the winds. The heat of the ground now serves to melt the snow more rapidly as it falls (648). The destruction of the forest and the grazing of the grasses have had effect to modify the flow of the Arkansas River. In the mountain areas these influences have decreased the average flow of the stream and also the minimum flow. On the plains the tendency is to increase the maximum and decrease the minimum, as floods are more severe there than formerly. Again, the soil is very much more absorbent in the forest than on the outside. When the forests are burned off the fire penetrates the surface soil, which is really vegetable matter, and leaves it hard and nonabsorbent, and the water runs off. The springs dry up because their sources are cut off, and hence, as is the common experience, a common fact of observation throughout the mountains, that the regions free from timber or where timber is burned off, are dry (649). The timber in the mountains is being rapidly destroyed. With the forests on the headwaters of the Arkansas River destroyed, as they are, even if the other conditions remained the same as to precipitation the flow of the river would not be the same as it formerly was either in character or in time (650). As conditions now are, the maximum tends to increase, if anything, and the minimum to decrease. Also, the average flow has decreased. As to time, so far as the river is fed by melted snows, the high water tends to come earlier in the spring instead of late, as it formerly did. The flood that comes from the melting of the snows under present conditions does not last as long as formerly, when the forests were in their original condition. No large part of the flow of the Arkansas River in eastern Colorado is supplied by the melting snows (651).

Witness, in speaking of the so-called "underflow" (beginning at 675), says among other things, in effect:

That he had made investigations concerning the same and knew of other investigations on the same subject made by officers of the National Government and others. Attended the hearings in this case during the summer of 1904 and heard references made by witnesses to the so-called "underflow" and its source or supply. Investigations made by witness showed that the underground water rose as you passed away from the river, showing it had some relation to the surface of the soil, approximately following the contour of the surface.

Witness further stated, in substance:

As you get out on the highlands it is deeper to the water, and as you get in the lowlands it is not so far to water. Perhaps this has led to the belief throughout Kansas that the water was at the level

of the river. That idea gave, roughly speaking, some indication as to how deep they would strike water, but actually the level was higher that the river in almost all cases. The indications are that the water rises as you go away from the river and becomes higher. Now, the water runs downhill and follows the slope underground as it does above ground. The notion that the water runs away from the river has been a very prevalent one in Kansas, and there are some conditions there that have made it, perhaps, not an unnatural supposition (676). As the ground rises the water rises (677). Since the idea struck the western part of Kansas that there was such a thing as an underflow, or "sheet water," as it was called frequently and indifferently, the conditions there were such as to keep that notion somewhat persistently in mind, and it has been mentioned in various Government reports. Similar conditions have been found along the Platte. The plains being underlaid with gravel, the water is generally found in the gravel, so that it has given the impression of sheet water, as it actually rises and falls very much as the surface of the ground does. The only outlet for this water is its slow passage downhill. The movement may perhaps be put at a mile a year. When a well is sunk into the gravel, the water runs in from the sides. A rapid flow into a well would be no indication of the movement of the water (680). Many of the witnesses for Kansas spoke of wells the water in which they believed to be on a level with the water in the river. In regard to this underflow, so far as we have been able to get at the facts from the measurements we have made, think that the witnesses were mistaken in their suppositions that the ground water was on a level with the river. From the investigations I have made, the Government cross-section maps, and all other information now at hand, I have arrived at the conclusion that what was commonly called "underflow" by the witnesses in Kansas during the hearings in that State, and which I have designated as "ground waters," draws most of its supply from the rainfall, while some of it comes from the river. In these conclusions in that respect I agree with Prof. Hayworth, of Kansas, and also with Hay, Follett, and others (684). While I am not now prepared to give a conclusive answer on the matter as to how far the river has any material or marked influence on the ground water, I would say that we have found that at a distance of a few hundred feet the ground water has risen subsequently to the rise of the water in the river. That this is due to the actual flow of the water from the river, however, is not evident. In fact, I think it is not the case, except to a very partial degree. The effect from the river decreases as the distance from the river increases. As to the effect of the river on the waters in the holes so close to the river, some of the water from the river as it disappears flows sidewise and acts partially as a dam to the water running into the stream, just as the salt water acts upon the fresh water flowing into the sea. If the water flowing in the Arkansas River in Colorado were allowed to go on straight through Colorado along the channel of the river, don't think it would make any difference in the water level in Kansas away from the immediate banks of the river. From my own investigations and the investigations conducted under my direction and those of others, my opinion is that the ground water in Kansas does not flow in well-defined

channels. It is simply water oozing through the layers of sand and percolating through the interstices (685).

Continuing the witness said:

"* * * From investigations we have made we have the level of the ground water at several places along the Arkansas river in Kansas. I had a line of wells run at different places at as near right angles to the river as the roads would permit; then to ascertain the height of the ground water wells have been bored down below the level of the ground water and the height of the water in these wells was determined at that time and at regular intervals afterwards. (Objection.) At Mount Hope, Kansas, a line was run north and south for a distance of six miles. This is a little west of Wichita and covers or goes into a portion of that delta lying between the main river and Little Arkansas river. While the height of the water at the river on August 26, 1904, was 3.49 feet, at 150 feet north the level was 3.63 feet from the same datum. At 660 feet, which is one-eighth of a mile, practically, 3.46 feet was the height of the water; and at 2,640 feet, about half a mile, or approximately, the surface of the water was 5.03 feet, or one and a half feet higher than at the river. At one and one-eighth miles the surface of the water was 7.14 feet, which was three and one-half feet higher than at the river. At two and five-eighths miles it was 11.49 feet, or eight feet above the water in the river. At 4⅛ miles it was 15.11 feet; at 6⅝ miles it was 17.63 feet. Opposite Colwich another line was run across the river north. This crossed the river a mile east of Colwich because of a bridge being convenient at that place. It then passed through Bentley and passed by places which some witnesses have testified about. On August 27, 1904, while the height of the water in the river was two feet, 200 feet north of the river it was 1.78 feet, an amount slightly less, though the observation at that point was defective because of the newly sunk well and because the water had not been given sufficient time to rise. At ⅝ of a mile the height of the water was 3.29 feet; at 1⅝ miles the ground water was 6.80 feet; at 3⅛ miles it was 11.70 feet, or 9.7 feet above the river. At 4⅛ miles it was 14.95 feet, or nearly 13 feet above the river; at 6⅝ miles it was 13.70 feet, or nearly 12 feet above the river. The well 3⅛ miles from the river is close to the town of Bentley and is at the corner of the tract mentioned by Mr. Hansen, a witness of the complainant at Wichita. We are running still other lines and taking measurements and levels that are not yet completed.

"I will explain a little more fully what I meant as to the river water acting as a dam to the ground water or sheet water as it comes in from the out-lying country to the river. I mentioned heretofore that the water flowed down hill where the 'down hill' might indicate the surface of the water underneath the ground and not the surface of the ground. If, then, from any cause, the water is raised at the mouth or the mouth is elevated, it decreases the slope and the flow is correspondingly checked. Now, that decrease of slope might be effected by water acting practically as a dam at the mouth as well as by anything else. So it is rather a check. The term 'dam' may be misunderstood, as it is not an actually impenetrable obstruction. But it has the effect of decreasing the flow of the water, and so long as the water at the mouth of the river, for instance, is higher

than the ground water in the adjacent sands, of course there will be a reverse current and the water will flow for the time being from the river into the sands, so that we have the water coming down the adjacent land into the sands and also running from the river back into the same sands. The combined action of the two gradually raises the ground water both ways in the immediate vicinity of the river. Now, we have numerous observations that illustrate that, and one I have selected this morning, almost at random, from the data I have. I have platted here the cross-section of the ground water at one series of wells at different times since the latter part of August. I have here a diagram marked Defendant Colorado's Exhibit 27. The horizontal distances are shown horizontally on the scale and the squares represent one hundred feet horizontally. The distances are shown on the lower line in figures; that is, 200 feet, 400 feet, etc., measured from the river. The vertical scale is exaggerated, as is commonly done in representing a cross-section or profile, and every square represents one-half of a foot. The actual elevations above the assumed reference line are given at each side of the diagram, as 1, 2, 3, 4, and 5 represent feet above the reference line. The bank of the river is assumed to be at the place marked zero toward the left-hand side. Then, in this case, in this series of observations, several swells were placed, one at five feet from the river, one at two hundred, one at eight hundred, and one at eighteen hundred feet. They are shown by circles on the lines. Our records were made after August 29th daily or semi-daily until practically the first of October, 1904. Records were again made on October 6th and 7th. I have taken the result of those measurements at four different times from August 29th up to the last of September, and then on October 6th. The reason for my taking them on October 6th and again beginning measurements at that time was because of the high water in the river which came a day or two before that. Dots were made on the paper showing the heights of the water found at those particular times, the dots and lines being drawn through this particular point. They are dotted in different ways, and the date is shown on the diagram. The upper line, which inclines to the right, shows the height of the ground water on August 29, and the inclination of the line shows the inclination of the ground water (687). In other words, it was higher at the well eight hundred feet from the river than it was at the river itself. (Objection.) The heights of the water in the intermediate wells are shown at the intermediate points, and in each case at the first date they are higher than the water in the river. The second line shows the corresponding fact on September 1st, the third line for September 5th, the next line for September 8th, and the bottom line for September 12th, and all of them show a slope of the surface of the ground water toward the river. Then, on October 6th, which immediately followed the flood of early October, we have a corresponding series of measurements made at the same wells. On that day the river was high—at an elevation of four and a half feet, very nearly. The first well shows a rise, so does the second, while the third and fourth have been going down continuously during the month. They do not show any effect from the elevation of the river. The diagram then represents the statement previously made, but the water from outside is still sloping towards the river as it is between

wells at eight hundred and eighteen hundred feet. The water is still sloping from the outermost well to the next to the outermost well, although from there to the river the slope is a reverse slope, from the river to the well. This reverse slope is accounted for by the rise in the river which took place at that time from exceedingly heavy rains—floods in the river above. As the river would go down the ground immediately adjacent to the river, which has been filled by the water running from the river, again drains out. That fact was shown by the five lines which are on the diagram at present, the five lines showing a gradual lowering of the surface of the ground water or water table from September 1st to September 12th, and also for the intermediate days, but they are not shown, on account of the confusion it would cause in the diagram. On August 29 the well 1,800 feet from the river had water in it which was 1.8 feet higher than the water in the river. On September 1st it was 2.10 feet higher; on September 5 it was 2.26 feet; on September 8 it was 2.13 feet; on September 12 it was 2.07 feet. These heights are the heights above the water in the river. That shows that the river fell faster than the water in the region outside" (688).

(Defendant Colorado's Exhibit 27 offered in evidence. Objection.)

Louis G. Carpenter, Denver, Colorado (Recalled for further direct examination). May, 1905.

Direct examination continued (1805):

"I am the same Louis G. Carpenter who testified in this case in Denver in the month of October, 1904. At that time I spoke of certain investigations which I had been carrying on and directing, and stated that they were not completed. Those investigations have been carried on since that time. The investigations which particularly relate to the ground water in the valley of the Arkansas river, its source, its movements and the influence or lack of influence of the river upon the ground water have been carried on since last October and up to the present time. These investigations have consisted first of a series of wells at different places along the river valley, sometimes wells sunk by us to the ground water; the levels have always been run over the surface of the ground and the difference in level of the ground water at the river and at these different points determined by actual leveling (1805). In some cases open wells, or wells of the people living along or in the vicinity desired to be covered, have been used. * * * These lines of wells have covered part of the country between Hutchinson and Wichita, especially in the neighborhood of Colwich and Mount Hope. They have been run there as near at right angles with the river as the roads would permit; that is, the roads were used rather than going across private property, and lines extended both north and south of the river in the vicinity of Colwich and at Mount Hope, and cross lines of levels and wells were run east and west. That second line would be more nearly parallel with the river than the north and south wells. At that particular place the river runs a little southeasterly, so that neither of them are quite at right angles with the river. They, however, give the means of showing the greatest inclination both of the surface and the ground water. There were two east-and-west lines north of the river and three lines north and south at that place. They extended about nine or ten miles from

the river. One of them extended nearly ten miles. South of the river there was also an east-and-west line connecting some wells near Mount Hope and Colwich, and subsequently another line was extended for a number of miles still farther south. Now, of these wells, sunk generally a mile apart, records were taken at pretty regular intervals of the ground water. That was since last August and up to the present time. It has not been at regular, prescribed dates, but it has been from four or five days up to two weeks' intervals. It was found that the change in the ground water was very slight and slow, and that observations taken at longer intervals of time would answer the purpose just exactly as well as those at shorter intervals. The distance of the first well from the river varied somewhat, but generally within a short distance—a hundred to two or three hundred feet. And then they were put at a regular distance apart. Several times we had two or three or four wells within the first half mile; then after a distance of a mile was reached the wells were placed approximately a mile apart, speaking generally. I carried the farthest of these wells back from the river on the Colwich line, north and south from the river, nearly eleven miles. Now, that was nearly at right angles. I was going to separate that set of wells, because on those we kept up regular observations. As to how the lines which I have spoken of as running approximately parallel with the river were situated, and how far they extended, and about how far apart these wells were placed, I would say those were also placed, in the vicinity of Colwich, Mount Hope, Bentley and Burrton at the road corners, a mile apart, and the line, which for convenience we gave the name of the Bentley-Burrton line, ran ten miles east and west. Afterwards that line was extended farther east on a special series, a little later (1806); and also from Halstead west the lines ran east and west for ten miles. The nearest one in that case was about six miles from the river, and about nine or ten at the other end from the river (1806, 1807).

"Yes, sir; these wells were sunk in ground left open for road purposes, but not in the beaten path of the road. * * * On the south side of the river a line of wells and levels was run connecting Colwich and Mount Hope. Colwich is several miles south of Mount Hope, and so this line zigzagged to connect the two places. It therefore runs near the river at two or three places and then runs away, as the river, as I have said, runs to the southeasterly. At some other places in the State some wells were also sunk on which records were kept for a short time, and regularly, but not so systematically as on these, and those were frequently close to the river, as at Mulvane and at Arkansas City, Derby, Hutchinson, etc. Now, the second class of wells which I spoke of were a series of wells run to determine the distance to the ground water. It was found in starting this series of observations that the change in the ground water was exceedingly small; it did not rise nor fall much; and consequently by taking a series of levels and distances to ground water we would get substantially the position of the ground water by a single series of records instead of a long series, and that enabled us to cover a little larger extent of country than we had at first in mind. It was also desired to see the explanation of some changes in the levels which appeared as we passed over a slight divide toward the adjacent streams, and to carry that on past these other lines of drainage, like the Little Arkansas and the

Big Slough, etc., and to see the slope of the water surface in its relation to these lines of drainage; hence there were lines extended in several different places, as, for instance, from Valley Center on the east of the Arkansas river across the Little river and the main river and the Big Slough to several miles southeast of the town of Maize. There was another line, that was the extension of the line I speak of as the Bentley-Burrton line, which was ten miles long. That line was extended easterly across the Little Arkansas river and several other creeks to the vicinity of Sedgwick, a distance of eleven miles in that direction, and then also lines were run across the river in the vicinity of Kinsley for a distance of about seven miles; and another line of wells extending south from a well between Colwich and Mount Hope for a distance of nearly seven miles. This line crossed the Big Slough, Cowskin creek, and several tributaries. There was also a line at Derby and Mulvane and Arkansas City on which the records were kept for a short time; also a line at Hutchinson extending out along the line of the Rock Island and Santa Fe in both directions from Hutchinson (1807) for quite a number of miles—I think it was about twenty miles in one direction and twenty-six in the other. The railroads leave Hutchinson nearly at right angles with the river, one to the northeast and the other to the southwest, so that the railroad was followed there because it gave a line more nearly at right angles than the roads, and thus the distance could be covered with a little less travel. In general, it may be said that the line of elevation of the water surface follows that of the ground (objection); that with the rise in elevation of the ground there was generally found a rise in the surface of the ground water, and if the ground descended, as toward the creek, then the surface of the water descended also. When a creek channel was reached the ground sloped toward the creek channel from both sides—that is, there was a depression—and in most cases it was found that the level of the ground water sloped in the same manner, that is, toward the water in the creek. In other words, the water in the creek was lower than the water in the ground on both sides. There were some exceptions. This is shown in the Burrton-Sedgwick line possibly as clearly as in any of the lines run, and as this line crossed some five lines of drainage, it has a variety of those ups and downs in the line. This line crosses a little tributary on the west side of the Little Arkansas, then the Little Arkansas within half a mile, a small creek bed nearly three miles east, another creek at a distance of another mile, and one at a distance of two miles, and another at an additional distance of a mile and a half. This line extended from west to east. Along this line there were, I should say, from thirteen to fourteen wells. Approaching the Little Arkansas river from the west, both the ground-water surface and the surface of the ground slope toward the Little Arkansas river. As we pass the channel of the Little Arkansas to the east both again rise—the surface of the ground and the ground water—so that there is a valley both in the water and in the surface of the ground. Between the Little Arkansas river and the small creek three miles east there is a summit in the ground surface, but apparently not in the water surface. In other words, the creek bed is higher than the Little Arkansas, and it seems to be higher than the wells in between, or at least higher than the water in two wells—well No. 7 and well No. 6. The ground water also slopes toward the next creek, which again

occupies the bottom of the valley both of the ground and of the water. Well No. 9 was between this creek, which seems to be without name, and the next creek east, which is sometimes spoken of or is commonly known as Jester creek. There were two wells sunk between these two creeks; both of them were above the water in both creeks—that is, there was a summit both of the land and of the water between the two creeks. Passing Jester creek, wells Nos. 11 and 12 are between Jester creek and the next branch, which is known as Gooseberry creek, and there is again a summit in the ground water, so that Gooseberry creek also is in the valley both of the ground and of the water (1808). Passing Gooseberry creek, well No. 13 was located and the water in that well was above the water in Gooseberry creek. On the line passing south, a mile west of Colwich, this general effect is not as noticeable as in the line just mentioned, but there is a very marked rise and fall of the water surface, so that Cowskin creek in that case is higher than the level of the water in the well on either side of it. As we pass south the water rises as the country begins to rise. Those I have mentioned have reference to the cross drainage, that is, running back from the river and crossing the valleys of streams. Now, there are other cases illustrating the general statement that the water varies with the rise of the country. At Arkansas City the wells went nearly three miles from the river. (Objection.) The lines passed westerly on a section line which, there, is nearly at right angles to the river. After the first half mile the country rises quite rapidly to the elevation of practically eighty feet above the river at the first road in the section, and to an elevation of slightly above one hundred feet at Mr. Baird's, a little over two miles from the river. The ground water then rose from the surface of the water in the river—(objection)—to an elevation of nearly 77 feet. West from Derby the line extended over three miles from the river. The road bends to the north and follows the river and then follows a section line. The country rose to an elevation of 24 feet above a point on the bridge across the Arkansas river west of Derby. This line crossed the Cowskin creek. There were five wells. The fifth one was west of the crossing of Cowskin creek and four were between Cowskin creek and the river. The water in the fourth well was the highest, and from there both sloped toward Cowskin creek and toward the Arkansas river; but the general slope was pretty uniform toward the river. Yes, sir; the slope of the water in a general way conforms to the slope of the ground. Now, other illustrations could be given specifically on almost all of these lines. These have been mentioned because most of them crossed some drainage channels. If we take the Colwich line, on that line the ground rose, passing north from the river, fairly uniformly to well 5, which was about five miles from the river; but the ground at well 6 was still higher than No. 5. Then the ground descended to the crossing of Kissaway creek, and after passing Kissaway creek the ground rose for a mile and then descended to the north toward Turkey creek, which is just north of Halstead, so that the level of Turkey creek above the datum at the river—the ground north of Kissaway creek was nearly 27 feet, and the ground at what I spoke of as well No. 5 was nearly twenty feet above the Arkansas river. The level of the ground water rose from the river, and reached its highest point at well No. 5, where it had risen thirteen feet above the river; then it descended

toward Kissaway creek, and there rose again to a point a little short of Turkey creek, and then descended toward Turkey creek; that is, the distance to water at wells 5 and 6 was greater than the distance at wells 2, 3, and 4, but (1809) the increase in depth was not as much as the increase in elevation of the ground, so that the water was constantly rising. Yes, sir; the water was constantly rising in elevation in the wells as compared with the river as you departed from the river. As you get away from the river the water in the wells was constantly higher as measured from the sea level or from the river, either one. The same thing is true in a general way on the Mount Hope line; that is, the north-and-south line passing north from Mount Hope and crossing the river at Mount Hope, the ground rising in the distance of seven miles sixteen feet and the ground-water surface rising between fourteen and fifteen feet. The other records have essentially the same characteristics; that is, the lines on the north side of the river in the vicinity of Mount Hope and Colwich show a rise in the ground surface and a rise in the water surface. On the east-and-west lines as you go east the ground shows a descent and the surface of the ground water also shows a descent that is pretty nearly parallel with the ground, except when channels are crossed. When those channels are crossed there is a slightly increased rapidity in general and a rise in the ground-water surface as you pass the creek on the other side. The greatest dip of the country in that locality is neither east nor south—that is, in that direction. It is southeasterly, which is parallel with the direction of the river. The river follows the direction of the general dip of the country there; yes, sir; and these lines I have spoken of as running east, or approximately east, are Mount Hope lines, running in the same general direction with the river. They were run in that way simply because of the fact that they were highways which could be used. I would have chosen, if the country had been absolutely open, lines at right angles and parallel with the river, which was impracticable, so I did the best I could. Yes, sir; the line of wells running parallel with the river ran with the dip of the country. The east and west lines were more nearly parallel with the river than the north and south wells at this place. There were two sets of lines run—that is, two characters of lines—one of which lines was, as far as conditions would permit, run at right angles with the river, and one set of lines, as far as conditions would permit, run parallel with the river; yes, sir; and the fall of the country is with the river. Yes, sir; at that place those lines which were run most nearly parallel with the river were also run with the fall of the country; that is, in this square that was the case; and those wells run most nearly at right angles to the river were run across the general fall of the country, but with the local rise or fall to and from the river, yes, sir. In this portion there is not much fall toward the river as usual, because the valley has been somewhat flattened out.

"The general characteristics of that country east of the State line, and in all countries, is of course a series of valleys, but throughout the plains region there is a general slope of the whole country easterly, quite a marked one (1810). The river valleys have broken that up with furrows so that you have a slope toward the river valleys besides, as at Dodge City, Garden, and elsewhere. At this place the side ridges have greatly disappeared. Throughout

the western portion of the State for 110 miles the Arkansas river runs approximately east or a little south of east, and throughout that part of its course the general drop of the country is from west to east, yes, sir, and the local drop along the river is toward the river from each side, yes, sir, that is, it would be a groove across the plains, and whatever direction the river takes from there on this same general drop to the east continues in either a greater or less degree, and the same local drop continues, only in less degree, that is, on the river, as you go farther east and farther south in the State of Kansas, yes, sir. It continues the same with slight variations due to local conditions (1810, 1811).

"These lines of wells were intended to be so placed as to show the general characteristics of the streams, taking different places, for instance, at Arkansas City, Derby, Mulvane, etc. This region near Colwich and Mount Hope was a region from which a number of witnesses had testified in regard to their recollections of the ground water, and these wells were put there to determine what were the facts. At Hutchinson that was at the upper end of the flattening out where the rolling prairie might be said to come to an end and a spreading out or flattening out of the country takes place up toward the Smoky Hill. Then, at Kinsley it was also a convenient place. Now, at Garden City, at Dodge City, at Great Bend, lines of levels had been run by the United States artesian and underflow investigation a number of years since, and those were all in evidence—those records—so special lines of wells were not run there to as great an extent.

"Yes, sir; these investigations which I have carried on along these lines since last October strengthened or confirmed me in my views as to the ground water as those views were expressed at that time. (Objection.) They confirm the conclusions which seemed to me then to be probable, but where we hadn't gotten as much data as I desired.

"As to what influence, in my judgment, the Arkansas river in going through Kansas has upon the ground water in the valley or in the uplands adjacent to the Arkansas river in that State, I would say (objection), as the ground water in the uplands is uniformly above the water in the Arkansas river, and as that in general seems to rise and fall—that is, its summits, variations in elevation—between the different streams, I think the ground water of the upland can be excluded, to begin with, as being outside of the influence of the main river. Now, in the bottoms, in general the water in the bottoms seems to incline towards the river; that is, the water in the bottoms is above the water in the river. When the river rises the wells showing the elevation of the ground water for a short distance from the river also show a rise. That we have not found in any case far from the river. It is at a moderate distance (1811). I think the greatest distance we have found has been from 1,000 to 1,500 feet. I do not for the moment recall one at more than 1,100 feet. The underground waters would follow the line of descent, the same as would be true of surface water, and thus if the river rose from one to two or three or four feet, while the water had been sloping toward the river there would be for the time being a reverse slope such as was mentioned and described in an exhibit put in in the direct testimony last fall, and thus there would be a condition where the river could

be contributing to the ground adjacent to the river for that distance. The rise of the ground water at a short distance from the river would be the resultant of some that might come from the river and some that was coming from the back country. I think I spoke of the river as acting as a kind of dam, by which I simply meant the same as if the river backed up over the mouth of a sewer—it prevents the free discharge of the water that is coming down from the country. And as long as the slope of the ground water away from the river is toward the river it must still continue to flow in that way, certainly if that is the greatest slope, and that would continue until some of those wells would probably rise. Now, when the river has gone down, then those wells close to the river have gone down and the general line of the slope of the ground water has become the same as it was before, which seems to be the normal line or condition of slope (1811, 1812).

"As to what my observations carried on indicate as to the general direction or movement of the ground water, I would say (objection), the ground water has been assumed to flow in the direction of the slope—and that is scarcely an assumption, any more than assuming that gravity acts there as it does elsewhere—and if the general physical laws act in the Arkansas Valley the water must follow the line of greatest descent, which, generally speaking, is parallel with the river, modified by the slope of the valley toward the river. Now, where that valley is marked then the lateral slope is much greater than the general easterly slope. Where that valley is smoothed out then the lateral slope is frequently not as great as that down the river. If the river were flowing directly east and the general fall of the country was to the east and the local fall on the north side of the river was toward the river or south, then as to the general direction of the movement of the ground water on the north side of the river, I would say the greatest slope on the north side of the river would be to the southeast. It wouldn't be quite south, nor east, but it would be a resultant of the two; and that movement would be a movement which might be properly described as toward the river and with the river, yes, sir, I think so.

"As to whether these wells which I sank in the various lines of wells in all instances showed the effect of a rise or fall of the river to a distance of as much as a thousand or 1,500 feet, I would say, there was quite a marked rise in the river early in October of 1904. In that case the well 200 feet from the river on the Colwich line rose also. The well ⅛ of a mile from the river showed no influence (1812). I don't think we have an instance as far as that. I find but two wells that are between 500 and 1,500 feet; both of these are about a quarter of a mile. Neither of them shows any clearly marked relation with the river.

"As to whether if the river would rise three feet it would raise the water in a well 500 feet away three feet or less, I would say, it is less; that is, the rise which follows in the well is less than the rise in the river, and it dies out quite rapidly, that is, the variation. As to whether the level of the ground water at the time of low-water flow, at a given distance from the bank of the river, was three feet higher than the level of the water in the river, and there was a rise of three feet in the river, assuming the rise to last any length of time from a week to eternity, as to whether the well at that point would

show any rise in the level of the ground water, I would say, if the rise in the river were for a short time, say a few hours, such a well would probably show no effect whatever; that is, the effect would be entirely secondary to the other changes which may take place in the well—to the change of temperature or other changes found to take place in the ground surface. If the rise in the river should remain or be a permanent thing or last for some time, so that these wells could adjust themselves, there would be an effect shown in the well, because that water would be flowing down from the upland to the stream, and it would reach such a slope that it would be of a permanent character; that is, the water would flow on by as fast as it reached it from the upland, and that would mean something of a rise in that well. It would be under the same principle as in a stream. You put a dam in the stream and it may affect the height of the water for some distance back, even above the level of the water at the dam—assuming, of course, that the level of the ground water at the point where the well was to be sunk was as high as the level of the water after the rise had taken place in the river; yes, sir.

"As to whether it would be possible for the river to actually contribute any of its water beyond that point, I would say, no, it would not. And as to whatever rise took place at that point where the natural level of the ground water was equal to the level of the water in the river, making allowance for the rise, as to what fact that would be due to, I would say it would be due to the water coming from the back country or to the water higher than that point, and as to whether that would be really the true point of meeting of the two, I would say, as I understood the case this was above the level of the water in the river and the point of the meeting of the water from the up country and the water from the river would be below that, at the level of the water in the stream. As to whether from my investigations I could determine what would be a fair average limit of distance from the stream through Kansas at which the ground water would be affected by the river in rises such as I know of from observations of those streams, I would say (objection) (1813). I have not seen anything from all the facts that we could find of the wells and from the rising and falling of the water in the wells close to the river that would make me think there could be over 1,000 feet; in fact, the variation which has been found would make me think that the width was less than that; and that would, in my judgment, be a fair maximum distance on an average through the State. (Objection.) Yes, sir; I think so. And at that distance from the river, approximately, as to what difference in the elevation of the ground water would be caused by a given rise in the river, I would say at that distance the rise and fall due to the river would be so small as to be negligible; that is, possibly .1 of a foot. No; not for each foot rise in the river. Not so much as that. A rise of the floods in the Arkansas river as they come down is not usually more than 4 feet. Those are the pretty good size floods. A flood of from 2 to 4 feet would not be apt to cause a rise of more than a few inches—from .1 of a foot to .5.

"As to whether I have any way of estimating what acreage of land could be affected by such a rise in the level of the ground water, assuming a strip one-quarter of a mile on each side of the river for the 310 miles of the river's length in Kansas, as is alleged in the

amended bill of complaint, I would say, well, that can be very easily computed. Yes, sir; I can state about what that would be. (Objection.) That would be a strip 120 rods wide and 310 miles long. At 240 acres per mile and for 310 miles it would be 72,240 acres.

"Yes, sir; I put down some wells in the vicinity of Colwich and Mount Hope, for the reason, as stated, that those places were chosen because of certain testimony that had been given in the case made by the State of Kansas in chief; and as to what was disclosed by these wells as to the water level of the locality, I will say there were several witnesses who testified as to their ownership of lands in the vicinity of Colwich, Mount Hope, and Bentley, and as it happened these lines of wells were by the places of nearly all of these witnesses, and where possible a well was put down in that vicinity. In several cases two wells were placed next to the land described by the different witnesses. For instance, wells Nos. 3 and 4 on the south Colwich line were both adjacent to the land owned by Mr. Harrison; one was at the northeast corner of his tract and the other was at the northwest corner, on the front of it—that is, on the road which ran right by that quarter section. The same two wells were also adjacent to the land which had been owned by Mr. Rutledge. Those were both fronting it. Mr. Rutledge's place and Mr. Harrison's place were on opposite sides of the road. As to the character of the land in these two places in the road, as to being level or otherwise having about the same elevation, I would say there is very little slope to that country. There is a ridge that has a little elevation, but as a whole that is a very uniform country. The water in these particular wells Nos. 3 and 4 is practically at the same depth from the surface—4 feet (1814). These wells were first measured on August 27, 1904, and Mr. Rutledge, as I understood from his testimony, stated that the water was nine feet and had gone down three or four feet. Now, wells Nos. 2 and 3, on that we call the Colwich-Mount Hope line, were adjacent to land owned by Mr. Breese, and we found the water in these wells five and a half and seven feet deep, respectively, from the surface. I am not sure that he stated how far the water was, but he stated that the water had gone down three or four feet, which would have brought it pretty close to the surface. Wells Nos. 6 and 7 on the same land were adjacent to the land owned by Mr. Tupper, who testified. Well No. 6 was 5½ feet, while well No. 7 was 4½ feet.

"As to when these four wells I have last mentioned were put down, with reference to the hearing at Wichita, I would say, well, those were early in October of 1904. Wells Nos. 12 and 13 of that same line were adjacent to the property of Mr. Huss. In October, 1904, these wells were 4½ feet to water, and in March, 1905, were only about 3 feet from the surface. I think he stated that the water was 6 or 8 feet from the surface. These wells were about 200 feet from his old house. Well No. 3 of the Mount Hope line was next to Mr. Jorgensen's place. This varied from 7½ to 5½ feet from the surface during the time of our observations, the first one being made August 26, 1904. I think I stated it was 16 feet. Well No. 4 of the north Colwich line was next to the place of Mr. Hansen. The water there was found at from 3 to 3½ feet from the surface. I think that his testimony was that it had been from 7 to 8 feet. This measurement was made on August 27, 1904. I believe he had two places. Well No. 3 on the

Bentley-Burrton line was also next to the other place concerning which he testified. The water there was less than 3 feet from the surface. I think he testified it was 6 feet. Well No. 6 on the north Mount Hope line was next to the place of Mr. G. M. Shive. The distance to water was 5 feet. He stated that the water was from 6 to 7 feet. Well No. 5 of the Halstead-Burrton line was next to the place of Mr. J. W. Shive. The water was found at a depth of 6 feet. I think he testified that it was originally 6, but that it had lowered 3 or 4 feet. I think one witness stated that on the distance of examination the depth to water at Bentley was eight feet. We have a well at the northeast corner of Bentley, and on August 27, 1904, that was practically 3 feet.

"As to what my further investigations and conclusions are as to the source of the ground water or that water which is found underneath the surface of the valley of the Arkansas river and under the uplands, in addition to what I testified when I was on the stand before, I will say (objection), the further examination of all the facts available and the continued study of the conditions of that valley have confirmed the general statements made last fall and confirmed the belief that the same general laws in that respect are acting there as elsewhere; that is, that when rain falls upon the ground a certain amount of it will (1815) descend into the ground beneath and that it furnishes the supply to the underground water there as it does everywhere else. Now, in this case that is evidenced or shown by the fact that this water rises as we pass away from the river; that we have, in general, the ground water higher than the drainage lines either way, and therefore that that water is contributing to these streams rather than the stream contributing materially, if any, to this ground water. We do know that the rain sinks into the soil. The amount which sinks in would be greater as the soil is more porous—in other words, more sandy. If the rain does not form surface streams, it also shows that it does not run off materially on the surface, and that is characteristic of quite a large portion of the immediate valley of the Arkansas River from Hutchinson, at least, west; that there are no surface channels—no surface streams—especially on the south side. Now, that would simply indicate that the water does not run off. If it did, it would make channels. Therefore, it must sink in. The ground is sandy, and in some of those cases it is pure sand, and hence of the rainfall under those conditions a very large percentage is absorbed by the ground and soaks down until it reaches a layer that is impervious, or until it reaches the ground water, and that helps to make the rises that we find in the ground water; and it is shown in another way also by the fact that in many cases the ground water rises after a rain. That shows a connection between that and the rains. As to whether a long drouth over a large area of country—and meaning by that two or three consecutive years in which there was little rainfall—shows any effect upon the ground water, I would say, very materially in many places. The contribution from the surface to the ground water must necessarily be less even if all the water sinks in. The fraction which is absorbed would be approximately the same; that is, the percentage, and with the higher elevations that water is all the time tending toward the lower elevations. In the course of a long series of years

that tends to reach a condition of stability; that is, a slope that remains approximately the same. But if that continues to flow, as it does, and the supply is stopped, there must necessarily be a dropping of the water under the higher elevations anyway. As to which would first show the effect of this continued period of slight rainfall—the water table under the uplands or the water table under the lowlands to which the uplands drain, I will say, well, I hardly know. If the lowlands were supplied only by the water from the uplands—that is, by the water soaking down through the ground—the uplands would show it first; but that is not the case. There is quite a large percentage of the rainfall that falls on the lowlands that also contributes to its water, and it therefore would be a question as to which has the greater effect, and as I have not considered the relative importance of those two, I would hardly feel prepared to say which was the greater without a consideration of the question involved (1816). As to whether it would take a period of considerable length of slight rainfall—less than normal—to make any considerable or observable change in the ground-water level, that is, of a foot or two feet in the level, over a large area of country, I would say, well, no. It would depend, though, upon that amount of excess or deficit. A period of excessive rainfall that came so it would soak in might be shown very quickly, and that period of excessive rainfall would show more quickly than a period of drouth, because that is immediate and is considerable. You may have an excess of six inches or a foot in a month or two if that soaks in. And if a drouth were considerable for a year or two, as to whether there would be a corresponding fall, or, if not, as to whether the fact of the slowness of the movement through the ground would have anything to do with that, I would say, well, there almost always would be a fall; but as to whether it would show a fall with equal quickness and to as great an extent as it would show a rise from an excessive rain, I would say no; it would not begin to show a fall so soon, because, as I say, you may have an excess of six inches of rain that soaks in that may come within a month or two that might be available. There is likely to be no drouth or few drouths where the deposit available amounts to so much within so short a time. And then the water as it disappears from other sources than evaporation, if it is by a gradual shoving out, that movement is very slow, and hence the settling down would be relatively slow.

"The amount of rainfall in extreme western Kansas would be close to sixteen inches. There is no station that I know of with any length of observations there on the border, but we do know that the general tendency is for the rainfall to increase easterly from the mountains on. At Garden City the rainfall last year was considerably above the average—26 inches, I think it was. It averages 20 inches at Dodge; it averages 30 inches at Wichita; and in 1903 at Hutchinson it was 27.63. The period is not long enough there to be as sure of its normal as at Wichita and Dodge, but it is between Wichita and Dodge. From Dodge City west in Kansas, as to how the country is with reference to showing very few streams or channels or places for the surface run-off, I would say there are almost none adjacent to the river; and as you proceed easterly, as to about where you begin to find that there is an available run-off which re-

quires channels to carry it, I will say the first perennial stream comes in at Larned, or possibly you may say below Kinsley, in Coon creek, and it then has perennial tributaries from there on, at Great Bend and Wichita, as we proceed easterly. And as to when the river in flood times sends water out into the sands even for 1,000 feet on each side of the stream, or a quarter of a mile, and falls, as to what becomes of a large part of that water which has been forced out into the sands along the banks of the river, I would say, its first immediate effect is, of course, a raising of the water and bringing it nearer the surface. As the river goes down that which is above the level of the river as it becomes low will soak back into the river, or its tendency will be that way (1817), because its slope then is toward the river, and if the water is close to the surface some of it is going to evaporate, the more as it is closer to the surface; that is, the evaporation will proceed more rapidly, speaking generally, as the water is closer to the surface.

"The evaporation from a moist sand surface is greater than that from a water surface, because the amount of evaporation depends upon the total surface, and the film of water covers the surfaces of the sand, and the total surface is really increased, hence it is found by experiment, as it might be anticipated, that the loss is absolutely greater when the sand is wet than if it were simply water.

"As to whether the Arkansas river increases in the volume of water which it carries in eastern and southern Kansas as compared with western Kansas, I would say the river shows in general an increase; that is, there are these tributaries which are coming in, and we begin to have the conditions more as they are in the eastern country where the water coming in is from a region of considerable rainfall and saturation (1818). * * * As to the velocity of the Arkansas river in Kansas, I would say I have the velocities from our measurements made at various places from Coolidge to Arkansas City and at different heights of the river. The velocity, of course, increases as the depth of the water increases. At Coolidge the velocity varies from 1½ feet up to 5½ feet between a gauge of 6 inches and a flood height of 4½ feet in depth. This is the velocity in feet per second. At Garden City the velocities were from 1¼ feet up to 3½ feet per second for the same variation in depths of water—from 6 inches to 4½ feet. At Dodge City the velocities range from 1 foot per second up to 3¼ feet per second for a variation in gauge height of from 1 foot up to 3 feet. At Kinsley the velocities range from .8 of a foot per second up to 3 feet per second. At Hutchinson, from 1½ feet per second up to 3 feet per second. At Wichita, from 2 feet per second up to 2.65 feet per second, not as much variation as at the stations above. At Arkansas City, from 1¾ feet per second up to 2¾ feet per second, for a variation in gauge height of from 1½ to 4½ feet in depth. Those are taken from the records made of actual gaugings. As to whether it is possible from that data to give the average velocity for the river throughout the State, I would say one would have to assume the depth, of course, but the general statement previously made of about 2 feet per second, I think it was, is correct for what might be considered the conditions that would ordinarily be met with. As to how long it would take in a moderately good stage of water for the water to go from the Kansas-Colorado State line to the Kansas-Oklahoma

line, I would say, well, we can put a minor limit to that in comparison to the floods. The velocity expressed in feet per second does not appear so large when put in miles per hour. You see a velocity of 1 foot per second is considerably less than a mile per hour. It would be, say, $\frac{3}{4}$ of a mile per hour. In other words, 3 feet per second would about correspond to 2 miles per hour. It takes about six days for the water to pass Kansas, of a pretty good rise, from Coolidge to Arkansas City. Of course with a small head it can't be identified lower down, so that except by estimates we can not tell, but a rise of several feet in the western part of the State in some cases can be followed down, and we have followed it in about six days. A less head will take a great deal longer time, and that gives it a longer time for disappearance, so that the time is not only longer, but the identity of the rise is lost, and it gives greater opportunity for evaporation; yes, sir. In my former examination I spoke of the loss in the flow of the water in the river in crossing the western portion of Kansas (1818), and as to whether I can add anything more on that subject on account of further observations I have made, I will say, well, I haven't them here this afternoon. The exhibits already presented of the floods shown in those exhibits are typical of the floods which have been traced, and while the laws vary somewhat according to condition, yet there is very much less variation than one might expect, and the general characteristics as they are shown are the same of them all. We have had a number of floods that have been traced down and we have been able to compare them. At that time I spoke of the percentage of loss between the State line and Wichita being equal to about 70 per cent of the amount crossing the State line, and I then stated that I was making a liberal allowance. As to whether I have had any reason to change that estimate, I would say, no, sir, I think that was a fair estimate. On that basis 30 per cent of the water would get to Wichita that crossed the State line, and that was based upon a flood of high water. As to whether that percentage would reach Wichita if I were to take the river in a low stage, I will say, no, sir; I think not. Below the normal or average, as to whether it is true that the less the stream flowing in the river at the Kansas-Colorado line the greater the loss in carrying it across the arid region—that is, the percentage of loss—I would say yes, the loss is greater, from the fact that the length of time it is subjected to evaporation and percolation in the sands is greater, and hence as you decrease the quantity the absolute loss may be less, but the relative loss may be greater. If an assumed average flow of 750 cubic feet of water passing Canon City could all be delivered at Little Rock without loss, as to what rise it would make in the river or what increased depth at Little Rock, approximately, I would say, if the river at Little Rock were at a 5-foot stage, which was below the average stage for 1903 and also below the first ten months of 1904—I say ten months because I don't have the November and December records—and accession of 750 feet per second would cause the river to rise less than .1 of a foot, and for greater depths the same amount of water would cause a less amount of rise, and that is because the width of the river is greater and the velocity is greater, both. This is taken from the rating curve or discharge curve furnished by Mr. P. R. Van Frank, United States engineer at Little Rock.

"I have heretofore stated that 30 per cent of the water crossing the State line would be a fair estimate as to the amount that would reach Wichita, assuming an average flow of 750 cubic feet per second of time as the amount crossing the State line or passing Canon City, either. As to whether any greater percentage of that water would get to Little Rock, I would say no, sir. If the average flow of the river at Canon City and Colorado, or at the Kansas-Colorado line is 750 cubic feet per second of time, as to how much per second of time that would mean as a delivery on the average at Little Rock on the basis that none was lost after it passed Wichita, I would say it would be a little over 200 feet—225 feet—and the amount that that (1820) would raise the river at Little Rock would be correspondingly less. Yes, sir, in 1903 at Little Rock the lowest average stage for any single month was in December, which averaged 3.6, while in March it averaged 18 feet, or, to be more exact, 17.8 feet (1821).

"* * * Ten feet per day is a fair assumption for the average rate of speed at which ground water will travel through sand and gravel such as that ordinarily found in the Arkansas valley in Kansas. Assuming this movement to be 10 feet per day of 24 hours and a width of territory of half a mile, or what would be equivalent to one-fourth of a mile on each side of the river and a depth of 100 feet, the substance being sand or gravel such as is found in the Arkansas valley in Kansas, as to what amount of water in a flowing stream would be moving through the assumed amount of sand and gravel, I will say, the quantity thus percolating through sand of that character at a rate of ten feet per day and in a strip half a mile wide and 100 feet deep would be very closely approximate to 10 cubic feet per second of time. This assumes that one-third of its volume is voids, which is practically true. It does not vary very much. It is sometimes one way and sometimes the other.

"Q. Counsel for Kansas, when he cross-examined witnesses in that State during the present month, asked many witnesses as to their knowledge of what is called the Eden flood, which occurred on August 7, 1904, (1822) in Colorado, and its effect upon the Arkansas river in Kansas. Will you state from your records of the river flow what, if any, influence the flood known as the Eden flood on August 7, 1904, had upon the river in Kansas?

"A. I have found no particular effect. To illustrate with Coolidge, a station in Western Kansas: The Eden flood, so called, was on Sunday, August 7. Now, on Sunday morning, August 7, the same day, there was quite a rise in the river at Coolidge.

"The Eden flood occurred on Sunday evening, while the rise at Coolidge took place on Sunday morning. It rose to nearly 2,700 feet at Coolidge on Sunday morning. Of course that was not the water coming from the Eden flood, as it takes about three or four days from Pueblo to get water down there. Now, on the 10th that had decreased to 75 feet. On the morning of the 11th the river rose to 285 cubic feet per second of time. Now, that rise on the morning of the 11th might possibly have been due to the Eden flood—from 75 to 285 feet. That, then, practically answers as to its effect farther down in the State. At Garden City there was a rise on the 9th, which is the same as the rise that took place at Coolidge on the morning of the 7th, neither of them due to the Eden flood, but one occuring pretty nearly the same day in the month. As to what influence

was made upon the river in Kansas in the way of showing to a less extent as one proceeded down the river in Kansas than at the places I designated, I would say it would show less (1823).

"The average flow of the river at Canon City for 1904 for the whole year was 588 cubic feet per second of time. This is below the normal, which I have just stated as 738 feet, so that it is more than 20 below the normal. It was below the normal in most of the months—that is, in March, April, May, June, July, November, and December it was below the normal. In August, September, and October it was a little above the normal—in one case by 140 feet, in August, by about 80 feet in September, and by about 180 feet in October (1825).

"If there were no ditches taking water from the Arkansas river between Canon City and the Colorado-Kansas line, taking the year as a whole, as to whether the river would gain or lose materially between those two points, I will say I think the river would lose.

"If in the amended bill filed by Kansas it is alleged that the average flow of the Arkansas river for ten months in the year at the Colorado-Kansas line, if no interference was had with the river above that point, would be in excess of 2,000 feet per second of time, as to what I could say as to the correctness of that statement from my knowledge extending over a period of 17 years as to the average flow at Canon City, I would say I think that would be largely in excess of the actual amount; and as to what my judgment would be as to the flow at that point, relatively, and as to whether I could give it within 50 or 100 cubic feet, I would say I don't know as I could get it within that amount. I could state some of the conditions, some of which are conflicting.

"Q. It would seem that one who had given attention to the flow of streams might be better able to give a conclusion than one who had not, and so if it is possible I would like to have you give your best judgment as to what that would be, whether it be a close approximation or not, from all you know of the conditions, and then you can state what you base that on if you desire to do so.

"A. Without the ditches the river would lose materially from 60 miles east of Pueblo (1825), and of the amount of water which passes Canon City at a good part of the year, a very small proportion of that would reach the State line—almost none. What amount of that might be contributed by the Purgatoire the data is exceedingly meagre. We know that it comes principally in times of floods, and the data as to that amount is almost too small to make a basis for a very good estimate. Now, of the amount flowing by Canon City, the probabilities are that not more than one-half would be shown at the State line without the inflow from seepage, and of that from the Purgatoire and those side channels, my inference is that that would not materially increase the river. The early travelers at times found the river discharging into the Arkansas river; but taking those into account I should not think they would add more than a couple of hundred feet on the average. They would run, of course, a good deal larger amount at times, and at other times they would practically not have any, so that would seem to bring the amount say from 300 to 500 feet.

"As to an average flow of five or six hundred cubic feet per second of time being a fair or liberal average for the amount crossing the

State line if the river were uninterfered with by ditches above, I would say, it seems to me that would certainly be a liberal allowance.

"As to whether there are any ditches or canals taking water from the Arkansas river or any of its tributaries in the State of Colorado at this time or have ever been at any time that are owned and operated by the State of Colorado, I would say no, sir; none that have ever been in form to carry water. As to whether there are any in form to carry water or anywhere near in such condition as to make them available for the diversion of water, I would say no, sir. As to whether as State engineer I was in touch with other branches of the State government as to the water matters and the administration of the water matters of the State, I would say that as State engineer I had charge of the water matters of the State, and usually knew of matters that were under consideration, and as to whether I knew or now know of any projects in hand by the State of Colorado looking to the diversion by the State of the waters of the Arkansas river and its tributaries, I would say, no, sir.

"Yes, sir; I was present at a large number of hearings in this case and have heard many of the witnesses testify. Yes, sir; I have noted in the testimony offered by the State of Kansas and also by the State of Colorado in Kansas, that many of the citizens of the western part of that State have testified that the rains which have fallen in that State of late years have appeared to be better distributed and better adapted for the growth of crops than in the earlier years (1826).

"During the spring and summer months, as to the direction of the prevailing winds in eastern Colorado, especially along the Arkansas river valley, I would say, well, the prevailing winds through all that section are from the west or southwest. That direction is such as would correspond with the general movement of the air in this latitude—that is to say, in Colorado in general and other places in this latitude. There are sometimes local causes that will make a little variation, but that is the prevailing direction. And that would extend into western Kansas; yes, sir. Yes, sir; I also heard the witnesses introduced by the State of Kansas testify that the hot winds had been much less prevalent in late years than formerly. As to whether the evaporation from two or three hundred thousand acres of irrigated land along the Arkansas river would amount to any considerable addition to the moisture of the area in that locality (objection), I would say I have carried on measurements in evaporation for quite a number of years, and the evaporation for several hundred thousand acres of ground under irrigation would be considerable. During the time it is wet in irrigation the evaporation would be greater than from a water surface of the same area, and of course after the water then had gone down from the surface it would be at a less rate. During June, July, and August, or other months when irrigation is practiced, which begins in the Arkansas valley a little earlier—say in May, June, and July—the amount of land wet would be considerable, and it must yield to the atmosphere a large amount of water in the aggregate.

"As to what amount of rainfall is deemed adequate for the production of ordinary crops—such as corn, wheat, oats, and the various crops of that kind—of course that is a question partly of distribution and of latitude as affecting climate. A rainfall coming at the proper time would be more effective, and therefore less rainfall that fell in

the proper months would be sufficient than if it fell in the winter months, for instance. It has very frequently been taken as 20 inches; that is, that the limit of successful agriculture is often put at that amount. That is an arbitrary line, and it can not be absolutely fixed, but it reaches a point where agriculture becomes precarious, at any rate, when it is less than that. Yes, sir; that arbitrary limit so fixed would apply as well to a latitude such as that of the State of Kansas as to other latitudes. That limit of 20 inches was first stated publicly, so far as I know, by Major Powell in his monograph on the arid lands some twenty-five or twenty-six years ago, and I have always had that in mind since, and it has been a very convenient and accurate statement, I think, of agricultural conditions.

"As to where would be a line across the State of Kansas, on one side of which line the annual rainfall would equal 20 inches and on the other side would be less, approximately, I would say the average rainfall at Dodge is very close to 20 inches—20.09 was the normal up to and including July of last year, dating from 1874, in October. Taking the territory east of a line drawn through Dodge City, as to whether the rainfall would be greater or less, I would say the rainfall in general increases as you go east and diminishes as you come west. Of course, in some years there are exceptions. The rainfall varies considerably (1827). There has not been one of the regular Weather Bureau stations for the keeping of rainfall records in Reno County, Kansas. There has been a volunteer at Hutchinson, I believe, for a few years, and as to the average rainfall for a year at Hutchinson, I would say that in 1903 the amount was 27.63 inches, and that from the general normal map prepared by the Kansas weather service must be very close to the normal for that place. As to whether that amount of rainfall in that latitude is generally considered by observers and those familiar with rainfall and its effects upon the crops sufficient to produce the ordinary crops—such as corn, wheat, and the various farm products—I would say, yes, sir. The distribution during the summer months is such as to make the rainfall most effective, because the rainfall of May, June, July, and August is a great deal greater than during the other months of the year. In other words, its effectiveness is large for its total amount.

"Yes, sir; the lands called the reformatory lands mentioned by the amended bill filed by the State of Kansas in this case are situated near the town of Hutchinson. I think they are in town. I know they are what I supposed to be within the city limits, but that may be wrong.

"Yes; from Hutchinson south and east along the Arkansas river in Kansas the annual rainfall increases over that shown at Hutchinson. Taking the distance along the valley of the Arkansas river in Kansas as 310 miles, as stated in the amended bill of Kansas, as to how many miles, about, of that valley lie within a region having 20 inches or more of rainfall, I would say Dodge City, which is at a point where the rainfall is 20 inches, is about 120 miles from the Colorado State line, so that it is a little more than one-third of the distance along the river that has a rainfall of less than 20 inches, and about two-thirds of it has more than 20 inches.

"As to the dates of the earliest ditches for irrigation in Colorado, excluding those of prehistoric times, so far as my investigations have gone I would say about 1858 or 1859, that is, we know that

there were some that have been proved up as of that date; and yet I perhaps ought to qualify that by saying that there were some communities in Colorado that we know of earlier than that date that were irrigating, but I don't know that their dates are on record definitely. Those are what might be termed the Anglo-Saxon ditches.

"In the valley of the Arkansas river in eastern Colorado, as to whether we find a water table or ground water similar to that which is found in Kansas and western and middle Kansas in the valley of the Arkansas river, I would say we strike ground water; yes, sir. The sheet water that is spoken of in western Kansas is not as prominent or has not been known as much as that in eastern Colorado, partly, I presume, if not largely, because there were no settlers in there making attempts to dig wells to any extent prior to the time of irrigation. Yes, sir; the irrigation itself would affect the ground water. In a portion of eastern Colorado, as in western Kansas, above ditches where they have wells it is quite a depth to water (1828)—from 40 to 100 feet—and that has been outside of the range of all the testimony that has been presented. By 'outside of the range of all the testimony' as to whether I mean outside of the range of settlement when you get beyond the ditches largely, I will say pretty largely so, yes, sir, in Colorado, though there have been some wells in eastern Colorado and western Kansas, both (1829).

"As to my having another line of wells which illustrates the comparative uniformity of the level of the surface of the ground and the level of the surface of the water underneath the ground, I would say I referred yesterday to the lines at Hutchinson running twenty-six miles northeast and twenty-three miles southwest. I have here the map of that line and the cross section of the country, showing the surface elevation and the ground-water surface also."

Defendant Colorado's Exhibit 31, just referred to, was here identified by the witness.

"This map shows on the upper portion thereof the section lines, the lines of railroad, and thus the map of the route followed, which was along the railroad. The lower diagram shows the profile. There are two lines shown in the profile. The upper one is the ground surface. Its rises and falls show the rises and falls in the surface of the ground. The second line, approximately conforming to the ground surface, is the water surface of the ground water as revealed by the wells which were sunk at different points along this forty-nine miles.

"Q. The second line you have just spoken of appears on the present map, Exhibit 31, in red. In preparing a map to be used in the case could you designate that line in some way to distinguish it from the first or upper line so that it could appear in print?

"A. To be shown in one color, that will be distinguished as a dotted line.

"Mr. DAWSON: We ask leave to substitute in place of this particular map one identical with it except that the second line referred to now appearing in red will be made in the form of a dotted line, so that it may be reproduced in black and white (1830).

"A. (Continuing:) This profile shows the valley of the Arkansas River and the valleys of several other streams crossed by the line (1830), as the Little Arkansas, the creek at Medora, and several other small creek valleys. The noticeable points are the elevation of ground between Hutchinson and the Little Arkansas, and the corresponding

rise in the ground water at that elevation of ground, so that the ground water rises there 60 to 70 feet above the lowest part of the valley at Hutchinson. The vertical scale is shown at the side of the diagram, in feet, above sea level. It is exaggerated, as is customary, and as it is necessary in profiles in order to show variations of the surface (1831).

* * * * * * *

"From my investigations of the Rio Grande, as to the characteristics of the river and whether it has any points of similarity with the Arkansas river, I would say it is a stream in which there are very great losses. It is a stream of the type of that characterized in the examination last fall as mountain streams; that is, with perennial tributaries near the head and no more perennial tributaries for a great many miles. There is therefore a long distance of nonproductive territory—longer in the case of the Rio Grande than the Arkansas, as the Conchas, rising in Mexico, is really the first perennial tributary for a long distance, and the stream loses water for a great part of its course. That was shown from a comparison of the records at San Marcial and El Paso, and more recently by a trip by the Government engineers, to be of the same character as those in which we have made seepage measurements in Colorado. That is reported in this same International Boundary Commission report and shows that of the water passing San Marcial at that time sixteen per cent reached Loma, the head of navigation. The stream differs from the Arkansas, it might be said, in one respect, in that the valley is generally relatively a narrow one and very frequently cañons up, and for a long distance, so that it has deep cañons, almost impassable, some of considerable length in New Mexico and still longer ones on the border of Texas, so that I think but one or two parties have ever descended the river, as it is a rock-bound cañon a good deal of the way. Nevertheless, but sixteen per cent of the water passing San Marcial has reached Loma (1833).

"As to whether my investigations have gone far enough to enable me to state with any accuracy the influence which irrigation in Colorado has had upon the Rio Grande, I will say no, the measurements there were not such as to determine that point with certitude; in fact, they were not directed toward ascertaining that point. We haven't a series of measurements. There have been measurements made at Embudo and at Del Norte, and after my summer in the San Luis valley a station was established at Conicero. I put a gauge rod that summer at this place, but no one lived at that time within a good many miles of there (1833).

* * * * * * *

"As to what has occurred, if anything, on the headwaters of the Rio Grande or its tributaries in Colorado with reference to the timber conditions, I would say, the timber on nearly all those mountains of the west has been cut off to a very great extent, as it has on all the other streams in this State; and as to whether the changes in character and time of flow follow in a general way the cutting off of the timber on the head of this stream as the changes which I have described as following a like destruction of the timber on other streams in Colorado—the Arkansas, for instance—I would say undoubtedly; and

there has been during the past few years, up to probably the past year, quite a shortening of the rainfall. I have had a rainfall station near Monte Vista part of the time, or a good deal of the time since 1888. That was a substitution experiment station, and that was situated in the San Luis valley in Colorado and close to the Rio Grande. That is about fifteen miles from Del Norte, where the river comes out of the noticeable mountains, so that the rainfall there was impressed upon me and I paid some attention to that, aside from my other interest in the valley. I have known of the fact a few years back that there has been a considerable shortening of the rainfall—and by 'a few years back' I mean for the past four or five years anyway, and, in fact, the high year which they referred to runs back quite a number of years ago. There was one high year some time in the '90's, but the last four or five years the crops have been short—those I refer to more particularly (1834).

* * * * * * *

"From my investigations, as to whether that which is described in the amended bill filed by Kansas in this case as the 'underflow' is, in my judgment, a subterranean stream flowing in a known or well-defined channel, or merely water percolating through the strata below, I would say it is not a stream, but in my judgment it is simply percolating water" (1838).

Cross-examination by counsel for Kansas:

"When I testified last October I was State engineer of the State of Colorado. I have been State engineer one term. My time has expired and I have not been reappointed. The present State engineer is Mr. Thomas W. Jaycox. After my direct testimony was taken last October I didn't have it printed, but the testimony has been printed (1838).

* * * * * * *

"In running the lines of wells I have testified to yesterday and today and in taking the measurements of those wells, as to how many of those measurements I have made myself, I will say that I have made none of them personally. Perhaps I ought to qualify that. There have been some of the wells that I have been to and made some measurements, but of those that I testified to, I think those were made by assistants working under my direction. No, sir; they were not State officers; they were simply persons employed by me to do the work, and simply made reports to me whenever convenient. As to whether these measurements have been going on ever since my testimony of last October, or since the testimony began at Wichita in August, I will say some wells were put down in the latter part of August, and the measurements have been continued on those ever since, and they have been increased in number and more extensive measurements have been made. I think I have mentioned or reported nearly all of the measurements that were made and reported to me.

"No; I think the Burrton-Halstead line of wells and the Colwich line of wells and the Mount Hope line of wells are not practically the same wells that I spoke of in my testimony in October. It is the same line at Colwich, and I think we extended the line at Mount Hope, but that is the same line of wells and was taken to indicate the same line and includes others than were then referred to. No,

sir; no variations were made from those two lines of wells referred to by me in my testimony of last October at the Mount Hope and Colwich lines (1839).

"There is a Coon creek near Kinsley and it rises southwest of Kinsley. Taking it from the land office map, a branch seems to head near Spearville, which is about fifteen miles from Dodge. The topographical map would put that on a larger scale, but I suppose that is close enough to what you want. I don't know of my own personal knowledge of another branch rising west from Spearville and near Dodge City. It doesn't show on this land-office map. Yes, Rand & McNally's map, which you hand me, shows a branch running near Dodge City. Coon creek, for a distance of eight or ten miles, is quite close to the Arkansas river, running a part of the way between the river and the bluffs, and I think it must be ten or fifteen miles that it follows within a mile or at least two miles of the Arkansas River. I don't know exactly from this land office map how long Coon creek is, but apparently something like thirty miles. Yes, the Rand & McNally map would show it to be something like forty miles. Yes, sir; it follows along the north bank of the Arkansas river to the town of Garfield and there empties into the Arkansas river. As to whether Coon creek or the Arkansas river for a number of miles along there is the higher, I will say I have a line of levels across Coon creek at one place; otherwise I can not answer, except from the contour map. On the 10th of this month Coon creek, where it crossed the road east of Kinsley, was above the river on the same line—that is, the water in Coon creek was above the water in the river about .4 of a foot, and that must be about three-quarters of a mile back from the river. As to whether there are any other places where the waters of Coon creek are above the waters of the Arkansas river, I will say I think that is the only place I have a definite level of. I don't know whether there is any place where the waters of Coon creek are below the waters of the Arkansas—that is, I have no measurements showing that. As to which way the land slopes from the source of Coon creek down to its mouth, between the Arkansas river and Coon creek, I will say, from the topographical sheet published by the Geological Survey, opposite Spearville—that is, between Spearville and the river to the south and west of Spearville—the portion next to the Arkansas river slopes toward the river. That is a strip that is two or three miles wide; then to the north of that a portion slopes toward Coon creek. On the north side of Coon creek it slopes toward Coon creek—that is, to the south. Yes, sir; the land on each side of Coon creek for a certain distance slopes toward the creek (1840).

"Yes, sir; Jettmore is on the Pawnee river. The fall of the Pawnee river from Jettmore to Larned is 266 feet and the distance is approximately between 40 and 45 miles. As to whether the fall of Pawnee creek from Jettmore to Larned is greater or less than the fall of the Arkansas river for an equal distance up the river from Larned, I can only answer that by reference to the contour maps. It seems to be very nearly the same distance (1840). Forty-five miles up the river by a rough measurement would seem to take you to a point six or eight miles below the river from Ford, which is at the contour elevation of 2,260 feet, and Larned is given on the contours of these same maps as 2,000 feet, so that the fall is very closely the

same either way. I think a line drawn at right angles to the general trend of the river at Dodge City and extended would pass very near to Jettmore. Yes, sir; Jettmore is 216 feet lower than Dodge City. Part of the way the land slopes from Dodge City toward Jettmore. From exact information I don't know whether the general level of the land at Jettmore is very much above the valley or the bed of the Pawnee.

"We have an exhibit which shows a cross section of that valley a few miles west of Jettmore, I believe. As to whether the general level of the land is just a few feet above the bed of the Pawnee, well, I havn't that impression. I have the impression that that slope is pretty sharp toward the valley. I don't know how much above the river the town of Jettmore is. We have an exhibit that has been presented in evidence, Defendant Colorado's Exhibit 24, which is a cross section across these valleys, that is, the valleys tributary to the Pawnee, and the Pawnee is straight north of Dodge. That runs six miles west of Jettmore. The valleys which it crosses are quite sharply cut. That land from Dodge City to the Pawnee and immediately west of Jettmore crosses a number of drainage channels, and that is all drained into the Pawnee, yes, sir. As to how near any of those tributaries or drainage channels rise to Dodge City, I would say that those I have seen have not had water in them when I visited them, but the nearest channel running to the north is within six miles of Dodge, north, I believe. I think there is a little ravine that starts right north of Dodge and runs almost north—northeasterly. I think there is a creek known as Duck creek that enters into the Sawlog that itself enters into the Pawnee. The channel of Duck creek is still farther north, about six miles, and that rises west of Dodge, and both of these ravines drain into the Sawlog, which runs into the Pawnee. I have not traced these down, but from my remembrance of the condition that is the case. Yes, sir; the water flowing on the surface of the land two or three or six miles north from Dodge City would drain northeast into the Pawnee river. Yes, sir; there is one branch of the Pawnee that rises up near Cimarron, known as Buckner creek. There is a tributary there; I don't know where it rises. There is one tributary or one ravine draining into Buckner creek that seems to head about two miles from the Arkansas river, about one mile north and a little east of Cimarron. No, it is about four miles east and nearly two miles north. As to the land from Cimarron to Dodge and one or two or three, or four miles north from the Arkansas river draining into the Pawnee, I would say, well, not so near as one mile, but from two to three or four miles, apparently (1841).

"As to the Walnut river rising and running along what is known as the divide between the Arkansas and the Smoky Hill, I would say I don't know about that region being termed the divide. I have never had occasion to notice that the Missouri Pacific Railroad from Hoisington straight west through that series of counties runs on the divide between the Arkansas valley on the south and the Smoky Hill on the north. Partly all of the waters from the four counties of Scott, Dighton, Ness, and Lane, and directly west of Barton County, drain into the Walnut. Part of each of these four counties seems to drain into the Smoky Hill, from the north part of the counties; yes, sir. Yes, that seems to be the case, that there is a divide running through the State of Kansas from Barton county west,

the Walnut river being right near the divide and draining south and east into the Arkansas, while the north portion of all those counties drains into the Smoky Hill.

"The Land Office map does not name Rattlesnake creek at all.

"Cow creek rises northwest of Hutchinson, the longest branch seeming to be in the extreme north of Barton county, north of Great Bend and a little east. Yes, it runs to the southeast, practically parallel with the Arkansas river, and its direction converges with that of the Arkansas. As to the bed of Cow creek being above the bed of the Arkansas river at a point reached by a line at any place drawn at right angles to the Arkansas river, I will say that at Ellinwood a line at right angles to the Arkansas river would strike Cow creek at the same elevation, as near as I can judge from the Great Bend topographical sheet. Opposite Sterling a line at right angles to the Arkansas river would cross Cow creek apparently at a lower elevation of possibly 20 feet. It may be a little more. If you take the same number of miles up Cow creek and up the Arkansas river from the mouth of Cow creek at Hutchinson, as to which is lower, Cow creek or the Arkansas river, I will say, opposite Nickerson a line drawn at right angles to the river seems to cut Cow creek at very closely the same elevation—possibly ten feet lower—taking this from the topographical sheet described as the Lyons sheet of the Geological Survey. In the upper part of Hutchinson, from the Hutchinson sheet it will appear that Cow creek is slightly lower than the Arkansas river at a point at right angles and directly opposite. As to how the land slopes from the Arkansas river on the north side between Hutchinson and Ellinwood, as to whether it slopes to the Arkansas river or toward Cow creek (objection), for some distance there is another small stream or valley known as Bull creek, and then above Sterling—that is, up the river—there is a strip several miles wide that seems to have very little fall at right angles to the river—practically none—so it is not clear from the map which way the water would flow. As we get in the vicinity of Raymond, then there is a strip three or four miles wide tributary to the Arkansas river proper, and that land north of that strip apparently drains toward Cow creek (1842).

"The Little Arkansas river seems to rise in the southern part of Rice county or southeastern part of Ellsworth county (1842), near Geneseo. It flows southeasterly, and practically parallel with the Arkansas river on the north side of the city of Wichita and there flows into the Arkansas river. As to whether the bed of the Little Arkansas river through its whole distance is above or below a corresponding point on the Arkansas river from Wichita, I will say I can not answer immediately to the full extent asked. At several places, as, for instance, opposite Hutchinson, at Medora, the Little Arkansas river is lower than the Arkansas river at Hutchinson. It is quite a little lower—I think about fifty feet lower. I have not consulted the figures, but from the profile I have I should think it was. I presume that is correct—that Medora is exactly 49 feet below Hutchinson—that is, at the railroad stations. Yes, sir; and at Buhler, six miles east of Medora, on the Little Arkansas, it is 59 feet below Hutchinson, according to these figures. Buhler on the map doesn't seem to be on the Little river, but near it. We have the exact differences between the two rivers on the line of elevations shown by

defendant Colorado's Exhibit 31. As to how the land slopes between these two rivers from Hutchinson and Medora on the north to Wichita on the south, I will say that between Hutchinson and Medora is a divide which parts the waters that flow into the main channel and into the Little river. North of that divide the waters run into the Little river and south of it they run into the Big river. There is one branch of the Kissaway creek, or else the main Kissaway creek, rises southwest of Halstead. Yes; there is one branch of that creek that rises very near to the city of Hutchinson, within a mile or two to the northeast. I should say four or five miles, perhaps, from the center of the town. Yes, and it flows a little south of east until perhaps five or eight miles north of Sedgwick and there flows into the Little Arkansas river. As to the Rock Island depot being due east of the Missouri Pacific depot on Douglas avenue, in the city of Wichita, and seven blocks away, I will say I don't know the number of blocks. It is on Douglas avenue or close to it and east of the Missouri Pacific. I presume that is the number of blocks; it is somewhere in that vicinity. Yes; the Missouri Pacific depot is on the east side of the Arkansas river and very near its bank, and it must be close to where the original bank of the Arkansas river was thirty years ago. According to the figures I quoted, the Rock Island depot is five feet lower than the Missouri Pacific depot. I presume that the compiler, Mr. Gannett, has adjusted these levels. They were made from the reports of the different railroads, and until I know whether he adjusted that I wouldn't know whether that meant that exact difference in elevation there, either one way or the other. You see what I mean is that the railroads as they are built bring in different elevations. In the city of Denver, for instance, the roads disagree by about 50 feet (1843).

"As to whether the flood of July 7, 1904, flowed southeast through the city of Wichita, I will say, well, I don't know about that. The flood flowed south on the north-and-south streets (1843), from the photographs I have seen. On Douglas avenue I don't know how it flowed. I don't know that it flowed east on the east-and-west streets. As to the general trend of the land and the trend of that flood, I will say I don't recall that I have learned anything or have seen anything that has given me the impression of an east-and-west direction there. Farther east I suppose it would flow east, because of Chisholm creek. Along there I don't recall having learned anything in regard to its east-and-west direction. I have photographs showing it flowing north and south on the north-and-south streets; I have one photograph that shows it close to Douglas avenue and about where the Manhattan hotel is. I don't know that it must have flowed east in order to get east on Douglas avenue as far as the Manhattan hotel. (Objection.) If I remember rightly, the Little Arkansas river is straight north, because the Little river bends to the west. I don't know that the city of Wichita from one or two blocks west of Main street to three or four blocks east of Main street slopes to the east. I know it slopes to the south. If the difference between the Rock Island depot and the Missouri Pacific depot is as given in that level—if those were adjusted—that would indicate some eastward slope. My impression is that the north-and-south slope is more than that. I have noticed that the surface drainage in the gutters on Main and Market and Law-

rence and Topeka and Emporia, naming them in their succession from the west, all flows to the south and the east (1844).

"Cowskin creek rises south of Mount Hope. Its head is a little north of west of Wichita, and in a straight line at right angles from the river it would be eight or ten miles. Yes, it gets nearer the Arkansas river than that. At a point a little southeast of Mount Hope it cuts within four miles of the Arkansas river, and then from that point at the nearest point to the Arkansas river it flows practically parallel with the Arkansas river and empties into that river near Whitman, about eight miles north of Oxford. It is south of Derby, at least. As to how the lands between the Cowskin and the Arkansas river slope, I will say that for nearly all of that distance there is another stream between the Cowskin and the Arkansas river. The general slope seems to be pretty evenly divided between the Big Slough and the Cowskin. Yes, the Big Slough is between the Cowskin and the Arkansas. Its beginning is nearly as far up as that of the Cowskin, but it runs into the river a great deal sooner that the Cowskin does—quite a number of miles sooner. As to whether the land slopes from the Arkansas river to the Big Slough and then from the Big Slough it is practically level over to the Cowskin, I will say it depends on what you mean by 'practically level.' There is a divide in between the two. There are no hills of any kind; no, sir. There is a parting of the waters there; yes, sir. No; the land does not slope toward the Cowskin on each side of the Big Slough. The land between the Big Slough and the Cowskin slopes both ways—that is (1844), toward the Big Slough and toward the Cowskin. That between the Big Slough and the Arkansas of course the water from that land is divided between the main river and the Big Slough, and I should judge from the contour map that the divide would be approximately half way between the two. As to which is higher, the bed of the Cowskin for its whole length or the bed of the Arkansas for a corresponding number of miles above the mouth of the Cowskin, I would say at the northernmost point of Cowskin creek the Cowskin is higher than the Arkansas, as shown by the Cheney sheet. That is the point. No, sir; that is not its source directly; that is down three or four or five miles from the source. As to the comparative elevations of these two rivers or creeks, from the contour lines of the Cheney sheet the Cowskin is nearly 20 feet higher than the main river at that place. Near Colwich the Cowskin would seem to be a little lower than the main river, to the northeast. Now, if you take that at right angles, it is doubtful from the map which is the higher. Yes; the Big Slough is between the Cowskin and the Arkansas along there. I don't know from personal knowledge where Garfield College is located in Wichita. I have not been over there. I don't know that I have seen it from the city of Wichita. It seems to me it was pointed out to me, but I have no recollection of it. Yes, sir; that is the one that is known as Friend's University, and it seems to be about three blocks south of Douglas avenue and three-quarters of a mile west of the river. I should judge so. As to whether I have learned that at that point the drainage is toward the Big Slough and into the Cowskin rather than into the Arkansas river, I will say no, sir; I have never heard anything about it. From the contour map the divide, I would suppose, would be a little west of that.

"As to when the first flood of 1904 that made any appreciable appearance east of the Kansas-Colorado line came, I will say, there was a rise in January at Coolidge, rising about 700 cubic feet per second. There was a small rise then in February, amounting to 400 feet. A flood at about the same time took place at Arkansas City a few days later, rising to 500 feet. That, then, could not have been the same one. I don't know the origin of this water. There was no flood in March at Coolidge. In May there was a very high flood at Coolidge, from May 2 to May 6. I think that has all been stated in the record, but it was away up. The highest was in the neighborhood of 10,000 cubic feet per second. The next one at Coolidge took place about the 27th. It began to rise on May 21. That ran up to a maximum of in the neighborhood of 12,000 cubic feet. Early in June there were great floods at Kinsley, Great Bend, Wichita and Arkansas City that don't show at all at Coolidge. That at Arkansas City was about the 2nd, and at the other places from the 2nd to the 5th or 6th. Then at Coolidge there was a small rise on the 7th of June, and a greater rise on the 9th (1845). That ran up to apparently something like 25,000 feet at Coolidge, at the extreme high waters. Then there was a flood about the 22nd. That is, the river had decreased at Coolidge and there were several rises. There was quite a high rise on the 22nd of June. That was still higher, being in the neighborhood of 30,000 feet, in fact our estimate at the highest water was close to 40,000 feet at Coolidge. That was above the gauging we had made, and therefore the elevation was one of estimate. Now, in July there were small rises at Coolidge, on the 5th running to 800 feet and over, dropping down on the 6th to less than 600 and rising then on the night of the 6th to 1,100 feet. That dropped down immediately and then jumped to nearly 3,200 feet on the 9th. On July 26th, there was a sudden spurt, running about 5,000 feet. Yes, there are records of floods at Hutchinson and Wichita during the month of July. At Hutchinson the river was high—well, it started in in the beginning of the month, July 1st, at about 2,600 feet and rose on the night of the 4th—in fact it was rising on the morning of the 4th—and remained above that height until the 10th, reaching a maximum of approximately 7,000 feet. That flood at Hutchinson dropped rapidly to the 12th, and then more gradually to the 23rd, when it was between eight and nine hundred feet. There was a heavy flood at Wichita on that date. That might be termed the same flood as at Hutchinson. It is not by any means the same water, because there were contributions in between of large extent. The water was high at Wichita all through that period, rising from the 1st to a summit on the 3rd, decreasing on the morning of the 4th and then rising pretty steadily to the 9th, when it seemed at its maximum, from the single daily observations. I think that flood at Wichita from the 7th to the 9th is the one that is referred to by numerous witnesses as the flood of 1904. That kept up relatively high until the 15th, when it dropped down to about 4,200 feet, and then it dropped steadily for the rest of the month. That flood must have extended up above Hutchinson, because at Hutchinson the river rose quite rapidly. As to Ellinwood, I don't know. That flood didn't show at Great Bend. There was a rise at Coolidge, as I mentioned, on the 9th of July. That was quite a rapid rise and one of

considerable extent, but it doesn't show at Great Bend or Dodge except in a very small rise. That water had disappeared so that the flood at Hutchinson was a different flood entirely (1846).

"On August 2 the river was high at Coolidge, rising a little over 8,000 feet. There was also a rise on the 7th of August, reaching 2,700 feet. Each of these floods lasted for a very short time. There was a rise on the 19th of August, the crest reaching 8,300 feet. Yes, sir; the Eden flood was on August 7, and this flood at Coolidge was not the one that caused the Eden wreck. The one that caused the Eden wreck on August 7, 1904, may have been the cause of the slight rise at Coolidge on the 11th. The river descended on the 10th at Coolidge to less than 100 feet; then it rose on the 11th to nearly 400 feet—between 300 and 400 feet (1846). That seems a little early for that Eden wreck flood to reach that point, but it couldn't have reached there before that. Yes, sir; the Eden flood flowed into the Fountain and from there into the Arkansas river.

"In September there was a rise at Coolidge, on the 4th, of very short duration, which rose to nearly 2,700 feet. That was the only rise at Coolidge except the beginning of a rise on the last day of that month. On the morning of the 30th it rose to 300 feet, and then fell in the afternoon, and rose during the night of the 30th and on October 1st.

"There was one flood in October. That was a flood that reached its maximum about the 1st of October, reaching the height of 27,000 feet. As to what flood caused the washing out of the Santa Fe tracks in Colorado and New Mexico, I will say, well, as to New Mexico, they were floods entirely disconnected from the Arkansas river, that is, over this portion. I may add that I am not sure about the floods on the Cimarron, which is a tributary, but excluding that, of which I know nothing, the floods at Trinidad about this date—I think September 30 or October 1—I am not at present sure of that date—it was essentially the same flood as this October 1st flood. That came from a general downfall of water that was very heavy through a large section of that country. Yes, sir; that flood overflowed the Santa Fe tracks at Trinidad and washed out certain portions. No, there were no other floods in October, nor were there any in December.

"As to my having made or having had made any measurements of any wells in Sedgwick or Reno county prior to August, 1904, I will say no, sir, I think not. Yes, sir; the measurements on August 27 and other dates near that were for the purpose of ascertaining the water levels of those wells at those dates. Yes, sir; all of those measurements made near the farms of Messrs. Harrison, Rutledge, Breese, Huss, Jorgensen, Hansen and the two Shives were measurements made after the 1st of August, 1904. Yes, sir; I stated in my testimony that we found the water level there higher than they had testified to it in their direct examinations. No, sir; they had not testified as to the condition of the water level on the dates on which we took those measurements. They testified, I think, in some cases as to the dates when they testified. Sometimes they were prior to dates. As to whether any of them pretended to give the water level at the particular date of their testimony, my recollection is that several did; that they said the level of the water is so deep now; and as to whether

the word 'now' was to be understood as meaning the date of their testimony, I will say I don't know whether I could put the entire connotation of that term as they used it, but I took it as representing the depth at that general time. As to whether I meant in my testimony to contradict theirs on that point or whether the date that they had set for a lower water level was prior—perhaps even months or years before—I would say, oh, it might have been (1847). As to whether I meant that I understood their testimony to indicate that at the particular dates on which I measured the wells they had found them four or five feet lower (objection), I will say no, I understood in most cases they were testifying from their general belief and not from measurements. As to the dates they were testifying to being months or even years prior to that, I couldn't say as to that. The depths which I testified to were the depths at specific dates, most of them or all of them, and at dates subsequently to their testimony, so that they did not state the depths on the dates that I measured the wells. (Objection.) In some cases I thought they meant that the water was then—at the date on which they testified—at the depths which they mentioned. Thus, Mr. Harrison, I think, said the water is 'now' a certain depth from the surface. I suppose he based that on his general belief, covering, it may be, some time. That I don't know. I will say in regard to Mr. Harrison's testimony that he did state afterward, I believe, that he didn't know the exact level on that day. As to my having stated that when I went north on those two lines—one at Colwich and the other at Mount Hope—the level of the underflow rose, and then when we went east it fell from that point, I will say the ground water was higher as we went north and was lower in general as we went east. As to what point in the river that water would leave the river to reach a particular well, I will say I don't know as it would leave the river at all to reach a particular well; in fact, my conclusion was that the water in the well didn't come from the river. As to the fact as to whether it came from the river or not, I don't know. As to what particular point in the river a rise would affect the level of the water in a well, I will say I can't answer that question, because it is not definite, so that I would not want to give a definite answer. As to whether it would be a point up the river from the well or a point exactly at right angles from the well or a point down the river from the well, I will say, water cannot flow up hill. Therefore, if the surface of the ground water rises from the river to the well, that would show conclusively that the well could not be supplied from the lower river. You can in every case go far enough upstream to find a point higher than a well, but it does not follow at all that the water will have come from a higher point up there (1848).

"As to whether I found a change in the water level at the well near Mr. Hansen's farm, I will say, well No. 4, at the northwest corner of Bentley and at the northeast corner of Mr. Hansen's place, from August 27 to March 13 showed no particular change. From August 27 to September 20 there was a descent—that is, a lowering—of the water amounting to a little more than six inches; then on October 4 and 6 it was higher, from this graphic diagram. It was so small that it could hardly be measured—perhaps an inch or two inches (1848). On the 14th of October, by that time it has lost what it had risen, and then a very slow descent took place, so that by

December 12 it was about eight inches lower than it was on August 27; then from there to the latter part of February it lost another six or eight inches, and then slightly rose on March 13th. That well is a little more than three miles straight north of the bridge on that section line—from the river. The river runs southeasterly and at the nearest point is about two and three-quarters miles from the well, according to the map. The general slope of the land at Bentley is toward the main river—that is, the slope is south, and, I presume, southeasterly. As to a flood on the surface at Bentley finding its way into the Big river or the Little river, I think it is quite likely that that would flow east of south into the Little river. From the topographical sheet of Wichita and Cheney it is not clear, but it looks probable that that would be the case. As to the measurements and observations of the level of the water under the uplands along the Arkansas river varying as much in height as the level of water beneath the bottom lands, I will say, speaking of the extreme changes, I am inclined to think that the wells on the uplands will show as great a rise as those on the bottoms, because there is a limit to the depth to which the water will sink in the bottoms. In our observations during these few months we have found a rise in some of the upland wells that has been very nearly as large as any in the bottoms. That is, speaking generally, though that is confined to a very small percentage of the wells, and the changes ordinarily take place slowly. As to what causes the rise of the water in a well on the upland, I will say it is the precipitation—the rainfall—entirely, so far as I know. To make that more complete, if the well is on a summit or divide where the water falls both ways, it is the immediate rainfall entirely; if the well is down a slope the height of its water will also be in consequence of the water that drains to it from the slope above, so that it is the rainfall at a second degree removed. * * * There is reason to think there is a periodicity in the rainfall. Taking a series of years, as at Wichita or Dodge City, the rainfall often shows a number of years that are above the average and a number of years below the average, and without feeling that it is safe to draw a general conclusion, it may be said that at Wichita the past three years have been above the normal. Of the three prior years, one was below the normal and the two others above the normal, and for the four years before that one was above the normal and then three below the normal (1849). * * * Several Kansas students of weather have spoken of the periodicity of the rainfall in Kansas. I mean by that that for a period of a number of years we would have the average for that series of years above normal, then for a series of years the rainfall would fall short of the normal. Thus, Chancellor Snow, of the University of Kansas, and Mr. E. C. Murphy, formerly of the University of Kansas and now of the Geological Survey, have so stated in printed reports in both cases, I think, considering that there was a period of about seven years (1850).

"* * * The State of Colorado has no ditches. The State of Colorado has built three reservoirs, but those were used to equalize the flow, and the State has no irrigation that I know of. * * * As to whether there was any well-defined level of the ground water in Colorado prior to the establishment of the ditches, and that there was not any such in the State of Kansas in the valley of the Arkansas,

if I understand that question I will say, yes, sir, so far as our information goes. In eastern Colorado, the country being so arid, there has been very little occasion to put down wells outside of an irrigated area. There have been some. Where they strike gravel over an impervious stratum they have found water there as they have in Kansas. These wells were few in number. The settlers or ranchers were few, and consequently there has been no particular thought or attention to the sheet water, which has been noticed with the increased number of wells in Kansas. Much of the conditions, though, speaking physically, of the ground, are the same. Yes, sir, I think it has always been true that within the valley of the Arkansas river in Kansas upon the first or second bottoms by digging down a few feet you could always strike water. As to whether that exact condition extended through the State of Colorado in the immediate vicinity of the Arkansas river before any irrigation ditches were established there, I would say I have no positive knowledge. I should think, however, from the conditions, that it must have existed. As to the first bottom lands in Kansas and the western portion of Kansas extending right along up the river with their same characteristics as far as Pueblo or Canon City, I will say in a portion of Colorado the bottom lands, I think, are of a more adobe character. Some of them are, at least. But they are underlaid with gravel, and when they would get down into the gravel they would strike water just the same. No; you don't always strike water in Kansas in the first bottom lands within ten or twelve feet. As to my knowing of any first bottom lands from the State line of Colorado to the State line of Oklahoma in which you will not strike water in twelve feet, I will say I only know from what the State geologist of Kansas says. He speaks in his report as State geologist of a lenticular area near Garden City where there is clay and where the water is not struck until they get through that. I can refer to that, if you desire. My own investigations have not covered all the bottom lands of Kansas. Yes; so far as my time and means would permit, I have been persistent during the last six or nine months in gathering information. In those areas just spoken of we have found the water in nearly every case—there have been one or two wells not far from the river where water was not found (1851). In one case in particular it was through or in a layer of clay, and water was not found in that clay at the time of sinking the well. Now, while the investigations or my direct measurements have not been such as to cover the whole ground, yet I think they have revealed the general conditions, and wherever we have an impervious clay you have got to get through that into water-bearing strata, whether on the upland or lowland. In general, you do not have very many of those cases, but I know of no reason why you will not have them at times, and where you do you will not get water until you puncture that, and then very frequently the water rises. I think in other places the water was found at a relatively moderate distance.

"Yes, sir, I quoted in my testimony one paragraph of a report by J. D. McKown, found in Executive Documents, third session Forty-fifth Congress, 1878–9, volume 16, and at your request I will read the whole of that report, with the exception of pages 10 and 11, including the last paragraph on page 11, introducing the whole of the report on pages 8 and 9 and the first two lines on page 10 and the last paragraph on page 11, as follows:

"'Report of Mr. J. D. M'Kown, Assistant Engineer.
"'United States Engineer Office,
"'St. Louis, Mo., January 27, 1879.

"'Major:

"'I herewith respectfully submit the following report of the examination of the Arkansas river from the mouth of the Little Arkansas river to Fort Smith.

"'In accordance with orders received from this office, I proceeded to Wichita, Kans., and commenced the examination of the river at the mouth of the Little Arkansas.

"'The latter stream empties into the main river a short distance above Wichita; part of the water is diverted from the natural channel to supply a mill, but again comes into the main river some 2½ miles below the city. The Arkansas river is very tortuous in its course, that portion from Witchita to Arkansas City passing through a prairie country, and has very little timber on the banks, a thin growth of cottonwood and willows prevailing.

"'The bed of the stream is very wide for the amount of water running, and is of a light sandy nature, quicksand prevailing in large degree. In many places where the current is strong there is a thin layer of gravel over the sand, which once broken through shows the soft sand underneath.

"'As we go down the river rock becomes somewhat frequent, rock ridges often crossing the stream, sometimes almost amounting to rapids, and leaving but little room for the passage of boats at low water (1852).

"'I had the advantage of seeing the river at a very low stage of water and in its worst condition. At no time during the examination was there a rise of more than 6 inches, and that lasted but a few days.

"'The distance from Wichita to Fort Smith I estimate at 409 miles, divided as follows:

	Miles.
From Wichita to Arkansas City	65
From Arkansas City to the State line	14
From State line to Grand River	236
From Grand River to Fort Smith	94
Total	409

"'The small amount of money available rendered rapid work necessary, and a hurried reconnoissance was all that could be made. On such information as I could obtain, I respectfully submit the following approximate estimate of the cost of improving the river for steamboat navigation at low water.

"'The Little Arkansas river empties into the Arkansas about ¾ of a mile above the bridge at Wichita. The bed of the main stream is from 600 to 800 feet wide from there to the bridge. The slope of the river from the mouth of the Little Arkansas to a point one mile below is 3.03 feet; high-water mark at Wichita from the best information obtainable is 7.45 feet above low water. The bridge at Wichita has the lower chord 10 feet above low water, but as the landing would probably be below it, it need not be taken into consideration.

"'From Wichita to El Paso, a distance of some 15 miles, the slope of the river is about 3 feet per mile, or 45 feet for the whole distance. The bed of the river is generally wide, and to within 2 miles of El Paso needs a continuous series of dykes and dams to contract it to a proper width, which would be about 150 feet. This would take a dyke of 600 feet every half mile for 13 miles, or 7,800 feet in all. About 2 miles above El Paso the river narrows down to about the required width, with not less than three feet of water in the channel. This extends for nearly 2 miles.

"'About ½ mile above El Paso there is a rocky reef extending across the river, runing out from the left where there is a rocky bank. The expense would be but slight to place it in good boating order—$2,500 would be sufficient.

"'From El Paso to Oxford the distance is 25 miles. The difference of level between the two places is about 69 feet, giving a slope of 2.75 feet per mile. This piece of river is a continuous series of comparatively short bends, and the water being forced on the convex side of them, forms a good channel in most places. It will require about 78,000 feet of dam for this distance, or 312 feet per mile.

"'About 1½ miles above Oxford there is a brush and rock dam which is built for the purpose of throwing in a race or ditch (1853), where it is used for mill power. The dam is a slight, irregular-built affair, angling downstream.

"'The difference of level of the water above and below it at the left bank is 1.37 feet. The right bank here is about 40 feet high and of talcose slate.

"'At Oxford there is a pontoon bridge. A roadway built to it is made of rock, brush, and prairie hay, the latter predominating, and seems to make an excellent dyke, closing the river in to about 150 feet, and making a good channel along the bluff for about a half mile.

"'Some four miles above Oxford the Ne-Ne Scah creek empties into the river, adding something to the volume of water.

"'Brush for mattresses is quite scarce on the river from Wichita to this place, but there is but little doubt that the tall, rank prairie grass, which is indigenous to this region, and grows in great abundance, could be used to advantage in the work by mixing it with the brush, and in all probability would be economical.

"'About ¾ of a mile below Oxford the river widens out and is full of bars. At five miles from Oxford the banks on the right are high and contain considerable loose slate. The river bottom is of rock, but there is a fair depth of water—from 2½ to 6 feet. About 14 miles above Arkansas City, the banks on the left are about 30 feet high, of sand and clay, underlaid with loose rock.

"'The slope of the river from Oxford to Arkansas City, a distance of 25 miles, is 65 feet, or 2.6 feet per mile. The approximate amount of water in the river at Arkansas City is 675 cubic feet per second. At this place there is a wagon bridge about 600 feet in length, with the lower chord 20 feet above low water. A draw would be necessary to allow the passage of boats. In the present state it is an obstruction to navigation.

* * * * * * *

"'That portion of the country tributary to the river in Kansas, from Wichita to the State line, is rich, fertile and well cultivated,

and would derive great benefit from the opening of the river to navigation. But where so much of the river passes through an almost uncultivated country, it is questionable whether the expenses of the improvement would be justifiable (1854).

"'Respectfully, your obedient servant,

"'J. D. McKown,

"'*Assistant Engineer.*

"'Maj. Charles R. Suter, Corps of Engineers, U. S. A.'"

Redirect examination (1854).

"As to whether or not I have any way of accounting for the rise in the well sunk near the place of Mr. Hansen of which (1854) I testified as varying from two to eight inches, or for accounting for rises of any greater extent than in general, I will say, well, rises of that amount or even more are very frequently due to rainfall, in fact a good heavy rain may cause a change of the ground water of a good deal more than that. Yes, sir, that would be especially true if the well were sunk in low ground where it would not only get the effect of rain directly, but the effect of rain draining from the higher country or of rain draining down, except that the rise due to the water draining down would be longer delayed, but it would then keep it up for a longer period. Yes, sir, rises like two or three inches are caused by other than an excess of water. For instance, a change in the pressure of the barometer has been found to cause a material effect on the ground water, and also a change in the temperature has been found to have a very clear effect on the water, but that is not so great in amount. As to the amount that might be due to an extreme change in barometer, I would say there must be a change of as much as an inch due to a change in barometer as shown by the graphic records reported in one of the Weather Bureau bulletins.

"As to what I can say as to some of the peculiarities of the country lying east of Hutchinson along the Arkansas river, I will say as you get down the Arkansas valley to Hutchinson and thence to Wichita there is a marked flattening out of the valley on the north or east side, and that extends northeasterly up into the vicinity of McPherson in McPherson county. That condition has been so marked that it has been the subject of monographs on some of its general physical features, as in the geological survey of Kansas, and the monograph there in the second volume of the Kansas geological survey under the title of 'The McPherson Equus' by the State geologist, Prof. Hayworth, with an assistant, Mr. Beede, showing a uniform physical condition, a region in which the slope is very small, a region where the sand beds are not far down and where water has been quite uniformly distributed. There is also apparent a marked channel cut down into the underlying rocks, so that in fact it has been suggested that the Smoky Hill river, which is now to the north, has at some time in the past flowed down through that region and cut that valley and has been the cause of this formation by the subsequent filling in of recent deposits. It cuts down below or across sandstones which are generally or always spoken of in that section as the Dakota sandstone, and which are the water-producing beds, wherever cut across, and furnish springs, as at the head of Sawlog creek and Buckner creek and Pawnee creek, etc.

"As to what effect, if any, this condition or these peculiarities of the surroundings there might have upon the lands as to keeping them well supplied with ground water, I will say, it gives those conditions which have been shown in that section, of water within a moderate distance, and as the country is so nearly flat and porous it gives the condition for a large absorption of the rainfall and a condition of country favorable to good agriculture and good crops (1855). That same region covers the region north of Colwich, Mount Hope, Bentley and Halstead, all of which are in that area.

"As to that place that I referred to where the change in barometer affected the level of the water to the extent of one inch, I will say that has been reported from definite comparative measurements at Madison, Wisconsin. That has been the only place I know of where I know series of records have been made in order to put those two changes so as to compare them. It has been known for many years that the flow of the water in drains increased or decreased with the barometer, but a comparison such as was made by Professor King has not been made before. Professor Hayworth, of whom I spoke, is professor of geology, or head of that department, in the University of Kansas at Lawrence. He is also State geologist of Kansas. As to having given considerable attention to the geological formation in Kansas and to conditions of water and having written upon these subjects, I will say that he has been the chief of the geological survey, and a few years since when Kansas formed, by act of the legislature, a board of irrigation survey and experiment, he was one of that commission, I think, designated as an advisory member by the statute, and made quite an elaborate report in the report of that commission on the ground water of Kansas, stating the geology of the underground water. As to whether he anywhere gives what might be termed a definition of underground water or underflow, I will say that he does. On page 79 of that report, more particularly designated the Report of the Kansas Board of Irrigation Survey and Experiment, 1895-6, to the legislature of Kansas, published at Topeka in 1897 (objection), I will read as follows (1856):

"'The term 'sheet water' is now about as widely used as 'underflow,' and practically means the same thing, so that in common usage the two terms are synonymous. The latter term expresses within itself the popular idea of the great lateral extent of the water and says nothing about its amount, while the former expresses the popular notion of movement and says nothing of the lateral extent. The 'underflow' or 'sheet water' is therefore the water so often referred to in the preceding pages, and corresponds with similar masses of water found in all humid parts of the world wherever we have in combination the two conditions, a loose, porous surface mantle of considerable thickness and a firm, impervious floor beneath, provided of course the floor is not so greatly inclined that the water will flow away as fast at it accumulates.'"

Cross-examination by counsel for intervenor (1856):

"In regard to how much lower the Little Arkansas river is than the Big Arkansas river in the vicinity of Wichita, well, at its mouth of course it must be higher, because it flows into the Big Arkansas river. Now, at the places above that I do not have definite levels (1856) so that I can put that in feet very closely. The topographical

maps would show that in a number of places it seems to be lower than the main river opposite. I think it is several feet lower above its mouth.

"No, I do not attribute the shortening of the rainfall in Colorado and New Mexico along the Rio Grande to the cutting off of the timber. I have never been able to see that the forests in the mountains could materially affect the precipitation. I have testified, though, that the forests did affect the preservation of the snow, and otherwise, but I have seen no direct effects that would lead me to a definite conclusion that it changed the rainfall" (1857).

Recross-examination:

"I spoke of the Report of the Kansas Board of Irrigation Survey and Experiment for the years 1895 and 1896 and read a selection from it. I will now read the last paragraph on page 186 of the same work at your request:

"'The Arkansas and Cimarron rivers would furnish a less amount of water than any of the others; a very large portion of the former's water is taken out in Colorado, and this will be increased in the future, it may be to the entire amount at the State line, except the large floods.'

"I presume that he had been referring to the Republican, the Solomon, Saline, Smoky Hill and Medicine rivers in the previous paragraphs. I have not noticed that.

"I do not personally know a man by the name of D. M. Frost. Yes, sir, he has an article in this same work, beginning on page 187, and at your request I will read the paragraph at the bottom of that page:

"'Since 1892, the surface of the Arkansas river has gradually failed, until in the year 1896 there was scarcely any flow east of the Colorado line; not because there was any diminution in the water supply at the sources of the river, but on account of the increase in the number and carrying capacity of these ditches constructed in Colorado, which absorbed all the waters and thereby left Kansas ditches unsupplied. There can, perhaps, be no serious objection to this, since Congress accorded to the State of Colorado that right when she was admitted into the sisterhood of States, but it leaves our ditch owners and farmers in a very precarious condition on this side of the Colorado line'" (1857, 1858).

Redirect examination by counsel for Colorado:

"I think Mr. D. M. Frost was a member of this board of irrigation survey; that he was president of it, appointed by the governor. He lives at Garden City.

"Mr. Dawson. In the examination of the witness Louis G. Carpenter he was inquired of as to the level of the water found in many wells sunk in the State of Kansas and as to the measurements of the distance between the surface of the land and the point at which the water was found, and as to the level of the water in these wells as compared with the level of the water in the Arkansas river. The witness testified that these measurements were made by persons in his employ and under his direction, and that reports were made to him directly. If counsel for Kansas will concede that if these persons were called as witnesses they would testify that the measurements which they made were correctly made and were truly reported

to Professor Carpenter, then the State of Colorado is willing to conclude; otherwise we wish to call said witnesses.

"Mr. ASHBAUGH. Counsel for Kansas concedes that if the parties employed by Professor Carpenter to make these measurements and reports were present and testified in the case they would testify that they made such measurements and correctly reported the same to Professor Carpenter; but we reserve the right to controvert such facts so reported and the conclusions drawn from the same by the witness who has just testified."

T. C. Henry (710):

"In reference to the general water level of the country within that part of Kansas within which I have operated and the connection between the water level and the streams, and as to how the water level receives its supply, my observation and experience in the valleys of the Smoky Hill river and its tributaries, such as the Solomon and Saline, is that the water level is higher and higher as you recede from the river and approach the base of the uplands, and that is true of the Arkansas river in Kansas, according to my information and my observation, so far as I have made any. This ground water receives its supply from the percolation of the rain waters of the great plains bordering the valleys."

Oliver P. Wiggins, direct examination by counsel for Colorado (738):

Age 81. First came to Kansas in 1838. Familiar with the Arkansas river in Kansas and Colorado. First saw it at Great Bend, Kansas, in 1838. First week in November. Crossed it with a Santa Fe train on a Santa Fe trail. Were there about a week. Was a good deal of water there at that time. Saw it again in 1839, about the middle of June, at a point near the mouth of Walnut creek, which heads in Kansas about 260 miles from Denver. Saw the river repeatedly from 1839 to 1848; in 1842 went with John C. Fremont on the Green river, and was with him at Salt Lake in 1843. Next saw the river in 1844, at a point below Rocky Ford, at a point near the mouth of Walnut creek. Saw the river in the spring of 1847. There was plenty of water in it up to the middle of June, when it began to fail very fast. I was a volunteer in the Mexican war and was wounded and did not see the river in 1848. Crossed it in 1849 with a wagon train going through to California. Came back in 1850. Saw the river in July, 1855, at Great Bend. In 1856 crossed it at Pueblo (738). At Great Bend in November, 1838, there was perhaps three feet of water in the river 125 to 150 yards wide. In 1839 started to go down the river again, and the same had gone dry. This was a little over 200 miles from where Canon City, Colorado, now stands. There were holes along the river, but it didn't run. The river never went dry at Rocky Ford—it always ran there. In 1840 the river went dry pretty nearly in the same way. There was no water running in the river from about the last week in June until August. In 1841 the river was pretty nearly the same (739). In about the middle of June, 1844, the river was in about the same fix—water holes along. About forty or fifty miles below Rocky Ford it disappeared. Below the mouth of the Pawnee, in Kansas, the water seemed to rise. The further down it went toward Great Bend the deeper the water got. In 1846 the river went entirely dry by the middle of June, and the

buffalo all left there. The water was sunk all the way from Rocky Ford that year. You couldn't get water by digging for it in 1846 (740). In 1850 crossed the river at Rocky Ford about the first of July. Plenty of water at that time. In 1854 went down the river about the 10th or 12th of June. It was terribly dry. There were water holes. Had to dig for water that year all the way down until I got to the Pawnee. During the earlier years that I was familiar with the river it almost always went dry in July. Only saw about four seasons that they had good running water in July. There was always plenty of water at Great Bend (741).

On cross-examination by counsel for Kansas (742):

Walnut Creek is above Great Bend about 200 miles. There was high water during the years I have mentioned. In 1855 the water was so high we had to ferry the goods across. We couldn't cross with the wagons. These floods all came from big rains. The river was always well up in May and up to the middle of June, and then it began to go down. The only time I ever saw the river in the fall was in the first week in November. Never saw it in December or January. Don't know how long the river remained dry during those years, but we went down in June. Understood from the Indians that it was very low and dry all winter. That would be during all the year (742). We hardly ever have any storms in this country until the last of June or July. By the middle of June the snow water has run off. In 1855 there was so much snow in the mountains that it kept up a big supply all summer (743).

Redirect-examination (743):

Had no way of measuring distances in those days except by the distance we could travel in a day. So many sleeps, that is the way we counted.

Frank B. Baldwin. Direct examination (743):

Age 62. Brigadier-general of the United States Army in command of the Department of Colorado. Headquarters in Denver. Been connected with the Army over forty years (743). First came to Kansas in September, 1866. Was then a first lieutenant and in command of a company. Marched from Fort Harker to Wichita in November, 1866. In September, 1867, left Fort Harker for New Mexico in command of 37th Infantry. Reached the Arkansas river near Fort Zarah; from there marched in the valley of the river to Fort Lyon, which is about thirty miles up the river from Bent's Old Fort. That was in September. Arrived at Fort Lyon the first of October. Crossed the Arkansas there. Spent the winter of 1869–70 at Fort Hayes. During that time frequently crossed the river near Fort Dodge. Went to Fort Larned in the Arkansas valley in the fall of 1871. Had a great deal of transportation and shipping to do, and crossed the Arkansas river frequently between Fort Dodge and Fort Zarah. The latter is not very far above Great Bend. Crossed the river many times between Pueblo, Great Bend, and Wichita with troops and wagon trains during those years, and traveled along its banks. Often between Fort Zarah and Fort Larned the river was a great, wide, sandy bed, with no appearance of a river. Then again found it, probably for some miles, with running water. The sand seemed to be on top and the water underneath. Have crossed the river and traveled along its banks every month in the year. Some-

times, without warning, a tremendous flood would come down the river that would tie us up so that we couldn't cross it (744). Have been tied up that way five days at a time, and then the water would almost entirely disappear. You could always get water by going down from a foot to four feet. The conditions I have spoken of in reference to the river being dry would extend for variable distances. Sometimes it would be twenty-five or thirty miles, and then again there would be a rippling of water on top, and this water would rise almost invariably at night. As soon as the sun came up it would disappear. This dry bed of sand extended all the way from Fort Larned to Bent's Old Fort. Never saw the river dry above Bent's Old Fort. Bent's Old Fort was in Colorado, about sixty miles below the present town of Rocky Ford. Never saw the river perfectly dry during that whole distance. Have seen it when the water was intermittent. It would run a few miles and then disappear, as it does in all the streams down there—the Cimarron, etc. As to floods, will say that in June, July, and into August always looked for the river to be full of water. It was said to have been caused by the melting of snow in the mountains. In other months there would be tremendous storms, and the river would rise without any warning and would go off as fast as it came. Had seldom to wait more than twenty-one hours for the water to run off. The buffalo had to hunt for water either in 1870 or 1871 (745).

In 1874 crossed the river at Fort Dodge dry shod. There was not enough water on the surface to fill a canteen. We could travel along the bank and see water for a few miles and then there would be no indication of water at all. Have been more or less familiar with the river from 1866 to the present time. Do not think there is any material changes in the condition of the river as to water since 1885, as compared with the conditions existing prior thereto. We always expected to see water in the river in June, July, and August, but sometimes it got rather low—just a little rivulet. It usually commenced to get low from the early part of September up until the next June (746). It usually got lower in July and August than prior to that time. It dwindled down so that by the latter part of September there was scarcely any water at all. In July and August there would always be some water running, but not very much (747).

Cross-examination by counsel for Kansas (747):

Don't recall that I have ever been at Garden City. Don't recall the location. There was no such town there when I was stationed on the river. Passed through there last July on the railroad. There was so much water there then that we were held up and couldn't move for two days. Have seen the river twenty-five feet deep in June, July, and August, and then again not an inch deep. When water was flowing during June, July, and August it would be on the average from one to two feet deep from Fort Larned to Dodge (747). The water during those months was attributed to the melting of the snow. These were not the months that we had rains in Kansas (748).

Redirect examination (748):

As to statement made on cross-examination that the water was high in the Arkansas river during June, July, and August, wish to be understood as saying that there was more water in the river then

Henry Hegwer. Direct examination (749):

Sixty-one years old. Live in Denver. Lived in Colorado since 1889. Lived in Kansas from 1857 to 1889. First saw the Arkansas river in 1859, near Fort Larned. Saw it again in 1860, at the same place. Saw it next in 1867, a number of times that year. Next saw it in 1871. Lived at Hutchinson, Kansas (which is on the river), from 1872 to 1889. In 1859 when I saw it there was no water in it. That was near Great Bend. It was dry at that time between Great Bend and Larned, a distance of thirty or forty miles. There was a drouth in 1859 and 1860. Buffalo were very scarce on that account. Saw a herd of buffalo in 1858 which extended in width eighty miles. It took them seven weeks to pass a given point. They left the country absolutely barren of everything (749). The next year the river was dry and there was no buffalo there. There was no water at Fort Zarah in 1865. In August, 1867, there was no water in the river sufficient to water stock. In the other years there was water in the river in the early spring, but along in the fall it was scarce from Granada down to Cow creek, a distance of two hundred and fifty miles. The last time passed up the river in a wagon was in 1880. Passed down by railroad several times. When living at Hutchinson saw the river almost every day. In the spring of the year there is generally a fair flow of water, sometimes bank full, and in low places a little overflow. In the fall there never was a time when you could not walk across it. There was always some water in July. Difficulty in crossing the river would be in May and June. There was always water enough for stock in July and August (750).

Cross-examination by counsel for Kansas (752):

Located a homestead in 1873 on the north side of the river, six miles west of Hutchinson, on the bottom. Reached water about five feet anywhere. Supposed that would be about the level of the river (752). The river was full of water in the months of May, June, and July every year. Whenever there was plenty of water in the river we always had plenty of rain. The rainy season during those years is generally in June. It hardly extends into July (754).

Redirect examination (754):

By high water in the river I mean a flow of two or three feet. During June and July the water would run up pretty high. It would then get gradually lower until the fall, when you could cross it without wetting your feet. Usually had more rain during the months of June, July, and August than in any other months.

Edward L. Berthoud. Direct examination (779):

Age, 77. Civil engineer. Lived in Colorado forty-four years. Lived in Kansas, at Fort Leavenworth, from 1855 to 1860. Was in the United States Army twice. Served in Kansas a while in 1855. In 1862 was appointed a second lieutenant in Colorado infantry (779). As an officer of the United States Army, was obliged to travel along the Arkansas river during the year 1863 from Pueblo, Colorado, to Walnut creek, in Kansas. Crossed and recrossed the river at various places. In June and July there was scarcely any water in the river at all. At the end of July and August crossed it dry shod. No water in it at all. No water in the river at Fort Dodge (780). Crossed the river about 45 miles above Fort Larned. There was no water running there at all except the little that came out of Coon creek—enough to water the stock (780, 781).

In November, 1863, no water in the river at Fort Larned (781). The river was entirely dry from the boundary of Colorado down to Fort Larned at that time (along in November, 1863). For about 250 miles down the river from the Colorado line there was no water in sight at all in the bed of the river. From July to November of 1863 it was dry up and down from Fort Lyon to Fort Larned. After May 1, 1865, saw the river several times between the mouth of the Walnut and the point where Dodge City now is. It was very low that year. There was water running. Meandered the river for the Government in 1869 from Pueblo east about fifty miles. The water was pretty low. This was between February 1st and March 31st (782).

Cross-examination by counsel for Kansas (782):

There was water in the river at La Junta and Pueblo after 1869 when I was there.

Deane Monahan. Direct examination (784):

Am a retired officer in the United States Army. Crossed the Arkansas river twice in the year 1861 at what was known as the Cimarron crossing, about fifty or sixty miles east of the present town of Las Animas, Colorado. Marched down the river in the month of June that year from the Cimarron crossing to Great Bend and returned in August. In going down, the river was low—fordable. Got a little lower as we traveled east. On the return trip in August there was no water in the river (784). Crossing the river in '62 at Fort Lyon, where Las Animas, Colorado, is now located, in September or early in October. About two feet of water in the river at that time. Was along the river again in '66. Was escorting a Russian prince who came westward to hunt. The river was then very low. You could only find a trickling stream occasionally. This condition existed all the way up to Fort Larned during that trip. The water increased as we went up the river to Fort Larned (785).

Cross-examination by counsel for Kansas (785):

Crossed the river in January, 1869, at Fort Lyon. The water was about eighteen inches or two feet deep (785). Never saw the river during the months of May or June when there was any running water in it (786).

William R. Beatty. Direct examination (786):

Age 66. Have resided in Denver 44 years. Was on the Arkansas river in the State of Kansas or the eastern part of Colorado during all of the year 1863. Was a member of Company F, First Colorado Cavalry, stationed at Fort Lyon (786). There was water running in the river all the time at Fort Lyon and for some miles below. It decreased as it flowed eastward. No running water in the river fifty or sixty miles below Fort Lyon, nor at Cimarron crossing. Was at the Cimarron crossing from June to September, and there was no running water at that point (787).

A number of other witnesses were called by the State of Colorado and testified in respect to the condition and characteristics of the Arkansas River in Colorado and western Kansas prior to the year 1885, but the testimony offered by such witnesses being nearly corroborative of the testimony submitted by Wiggins, Hegwer, Baldwin, Berthoud, Monahan, and Beatty, it is not deemed necessary to make any citations from or reference thereto, except to give the names of the witnesses and the pages of the printed abstract where their testimony may be found. Harris A. Newton (788–790); Robert Rob-

erts (790–793); William A. Perry (793–794); Henry T. Galbreath (794–800); F. W. Swanson (800–807); James Gallena (807–812); B. D. Spencer (813–817); Robert Finley (817–818); Anthony Bott (818–822); Henry McAllister (822–827); T. B. Pyles (827–831); A. Z. Sheldon (831–834); John R. Sitlington (834–836); J. S. Logan (844–845); Henry C. Beckham (845–846); John Pierce (846–847); James A. McCanless (847–848); John Ross (848–851); George Gilbert (851–853); John J. Thomas (853–857); Oliver H. P. Baxter (857–859); Lewis Conley (859–865); P. F. Lull (865–866); Granville G. Withers (866–867); C. B. Schmidt (867–876); Harley Sanderson (876–877); William A. Watson (877–878); Henry H. Bourne (878–880); S. S. Smith (880–882); William G. Gobin (882–887); H. M. Fosdick (888–891); J. W. Beatty (891–892); Humphrey Best (902–903); Oliver B. Stauffer (903–906); George W. Swink (908–919); H. W. Potter (919–920); J. B. Lynch (925–926); M. H. Murray (929–930); Reuben Irwin (930–933); John Murphy (933–935); J. K. Doughty (935–938); C. P. Thoman (938–945); John Gores (945–947); William W. Jones (959–963); Marsena J. McMillin (970–972); W. J. Johnson (972–973); Charles Bobbenreith (973–974); Henry B. Sager (979–983); Samuel N. Johnson (983–985); George W. Thompson (985–989); J. O. Packer (989–990); Walter N. Houser (993–998); Claudius V. S. Hart (998–1001); Daniel L. Taylor (1004–1007); S. J. Capps (1010–1015); J. O. Albert (1019–1022).

Henry B. Sager testified, among other things, in effect (979, 980):

That the Cucharas river is a tributary of the Huerfano, the latter being a tributary of the Arkansas in Colorado, and that the precipitation, more particularly of snow, during the last few years since 1900, in the mountain ranges between the Huerfano and Cucharas rivers, has decreased fifty per cent in comparison with the years during the seventies and eighties, and that it began to decrease since 1887; that lakes that were formerly filled were now dry, and that the streams named do not carry as much water as formerly.

George W. Thompson testified, among other things, in effect (986):

That there is not nearly as much snow since 1900 as before in the mountains at the headwaters of the Purgatoire, a tributary of the Arkansas river in Colorado.

Clinton B. Sharp testified, among other things, in effect (991):

That the fall of snow at the headwaters of the Huerfano has materially decreased since 1900, and that as a consequence the waters in said stream have dropped off in proportion.

Walter N. Houser testified, among other things, in effect (994):

That at the headwaters of the Huerfano the fall of snow during the last ten years has fallen off fifty per cent as compared with former years, and as a consequence they don't have the same high water in said stream as formerly. That other conditions have taken place, namely, the verdure is not nearly as great as formerly on account of fires (994). The timber has been cut off. Cattle and sheep have consumed and destroyed the undergrowth. Formerly the winds carried the snow into the heavy growth of timber, and the shade of the timber preserved it. The cutting of the timber and the destruction of the undergrowth and the cropping of the grass by stock permits the snow to evaporate and to melt earlier than it used to and to allow the rains to run off more readily (995). The denuding of the forests

has been confined mostly to Government lands. Don't think the destruction of the forests affects the amount of snow that falls, but controls the melting of the same (996).

Claudius V. S. Hart testified, among other things, in effect (999):

That he is acquainted with the headwaters of the Arkansas river and that since 1898 or 1899 there has not been 50 per cent of the snowfall there was formerly (999). That the timber has been cut off, beginning in 1876; that if this cutting is kept up at the present rate there will not be a stick large enough there to make a whipstock (1000).

Jesse F. McDonald, governor of Colorado, testified, among other things, in effect (1002):

That in and around Leadville the headwaters of the Arkansas river proper the decrease in the fall of snow since 1900 has been at least one-half as compared with what it was prior to that time (1002). That all the accessible timber near the headwaters of the stream has been cut off or destroyed by fire (1003).

Joseph K. Kincaid testified, among other things, in effect (1008, 1009):

That the snowfall at the headwaters of the Huerfano has decreased, and that there is not nearly as much timber there as formerly.

Other witnesses testified to the falling off of the snow in the mountains in Colorado during late years, among them S. J. Capps (1010-1015), J. C. Paddock (1015–1019).

(c) *Intervenor's Witnesses.*

Willard D. Johnson. Direct examination (1221):

Since 1879, with the exception of about a year and a half, have been connected with the Geological Survey of the United States. Have made a study of what is known as sheet or underground waters in the plains regions of the United States (1221).

With Prof. Newell, of the Geological Survey, was a student of underground water problems for two and a half years. Made a written report of his views in respect to sheet or underground waters. It is found in the 21st annual report of the Survey and is entitled "The High Plains and their Utilization." That report deals with the underground waters in the valley of the Arkansas river from a little west of the Colorado-Kansas boundary line into central Kansas. My deductions with respect to the extent of that sheet water are that the ground everywhere the world over contains ground water. In the Great Plains region the ground water is buried under a sheet of gravel and sand, which, together with clay, covers the Great Plains rough rock surface and is saturated with ground water up to some level varying in depth below the surface, which is called the ground water surface, or the water table. It is a universal plane. This ground or sheet water extends under the surface of the plains everywhere. There is no particular difference between the sheet or underground waters in the Arkansas valley and the sheet or underground waters of other plains sections in character. The principal subject of my investigations in the plains region was in respect to the source of these sheet or underground waters. From the investigations I have made with respect to this matter I would say that the origin of underground waters everywhere is rainfall. The investigations I made in Kansas and Colorado were confined to the Arkansas valley.

but mainly in Kansas west of Dodge City. Previously I had given very much and very detailed study to the Colorado-Arkansas valley up to the headwaters, having surveyed the whole drainage basin of the river (1222). Made an examination of the ground waters by sinking wells to determine its level and its slope, except where wells already existed which would serve the same purpose, and I found that the ground water surface rudely paralleled the ground surface, but was not quite so irregular. It was a great sheet, I should say. The river in Colorado and well out toward Kansas, but not reaching to Kansas, is a perennial stream. A little west of the Kansas line it is normally an intermittent or dry stream, with a flow occasionally in floods. The Arkansas valley coincides with the ground water surface along its course from a little back in Colorado well into Kansas. In the nighborhood of Dodge City, Kansas, the ground water supplies that normally dry stream there—the Arkansas—and makes a new stream, starting from the ground water and flowing eastward, so that the Arkansas river is really two streams. In Colorado it drains the surface water of the mountains and carries that water eastward where it runs off into the sand on either side or evaporates. There is then a long break or intermittent or dry stream. It then begins again by inflow from the water shed, dipping to the valley from either side, and flowing in in excess of the loss by evaporation so that it makes a visible stream again (1223). I sank a hundred wells, two or three of them in the stream. It was necessary to go but a few feet to find water in the dry season. Had many wells on either side of the river. Some of them in Garden City on the second and third benches and some of them on the uplands. Had a line of wells running north from the river six miles, and then at right angles with that line of wells and parallel with the course of the river, but pretty well above its bed. In the five or six mile line of wells, had some twenty odd. Could find ground water in the bed of the stream by scratching the gravel, but on a ten-foot bank had to go about ten feet to strike water. The ground water plane sloped toward the river. It was feeding into the river bed. As we worked back from the river the water planes were deeper and deeper, and on the uplands it was 45 feet deep from the ground surface to the water plane. The water plane on the upland was many feet above the river. Was surveying the water plane. The water plane arose away from the river northward at a rate that gave a slope of ten feet to the mile or thereabouts. The wells did not indicate the current of this sheet or underground water. I determined the fact of movement but not its rate. The movement is slow and it will have to be investigated for a very long time before the rate of movement is actually determined. I determined the general fact that the water plane sloped and that the ground water body moved. From my investigations and study of this question I would say that the source of this sheet or underground water in the valley of the Arkansas river is from the ground water on either side drawing in towards the river on that slope. Outside of a little, narrow, insignificant belt close to the river, I would say that absolutely none of the ground water comes from the flow in the river itself. It is impossible (1224). Speaking generally of the river, I should make the general statement that the normal river that runs continuously comes from three

sources of supply, one the precipitation which falls directly on its surface; another that falls on the surface and runs into it (the river) without going into the ground, and another amount, varying, which falls upon the slopes tributary to it and runs off into it. The third source of supply, the normal, steady, persistent source, is from the ground water. The river a short distance east of the boundary line between Colorado and Kansas to about Dodge City is an intermittent or normally dry stream. I made observations in respect to whether or not the water in the wells there dug would rise and fall with the rise and fall of the stream itself in the bed of the river. A few feet above the river the rise in the river had no influence on the wells, because the well surface was above the river. A rise in the river would influence the wells a few feet away an inch or so. A well several yards away from the river was not influenced by a rise in the river. I explain the coincidence of the rise and fall of the water in the wells close to the river with the rise and fall of the river in this way: It is two kinds (1225). I should not say that the river water came into the well, but that the water running down grade to the river was backed up against the river water. The river bed, probably, across its cross section, was still receiving contribution upward from the ground water, even in flood, but where the river manifestly overflows its banks and onto dry ground it will lower into the ground and contribute to the upper surface of the ground water, but only a narrow belt (1226).

On cross-examination by counsel for Kansas, witness stated, among other things, as follows (1226):

The investigations referred to were made in 1896 and 1897 during the summer (1226). My observations in the Arkansas valley extended from the headwaters of the river to Dodge City. Dug no wells as far down as Dodge, but examined some there. The wells I dug were in Garden City and vicinity. All of them were dug in a belt four miles wide east and west and some six or eight north and south. The level of the ground water at Garden City during 1896 and 1897 varied over the same according to the level of the terrace on which the city lies (1227).

From the information which I could gather in and around Garden City from old settlers and other sources I found that the ground water there had varied greatly within fifteen or twenty years. Where the depth to ground water was twelve feet it had lowered from four feet. In explanation of this will say that there was an irrigation-ditch system taken out a little east of the Colorado line for distributing water above the city during the growing season, and the water sloping into the ground raised the ground-water level until it stood four feet from the surface at some places. During the period when Garden City was watered from ditches the ground-water level was much higher than before. The ditch period went back of 1888 or somewhere in that neighborhood. Subsequently the irrigation ditches failed by reason of more water being taken out of the river above their source and became dry ditches (1227, 1228). I have no doubt but that the ground water was raised into the well and into the cellars in Garden City by the flooding of the ground through the ditches. I inquired into the condition of the cellars before the ditch period in Garden City. My object inquiring was to see what the condition of the ground water was previous to the ditch period.

During the ditch period I was told that the ground water was several feet high, and when the ditches were no longer used the ground water was lower. I do not mean to say that the whole plane was lowered by such an insignificant cause, but merely around Garden City (1229). If it be true that the level of the ground water in and about Garden City for a number of miles up and down the river is now and for ten years past has been from three to five feet lower than it was before affected by the Garden City ditches, this is not explained by any interference by man. Do not know that any scientific man is capable of explaining it. I attribute it to the changed climate; to the oscillation of climate, not a permanent, but almost a secular change. Can say this much, however, positively, that it could not possibly be affected by any change in the flow of the river; that the river flowing below the ground-water plane could not change the ground-water plane above its level (1230, 1231). As to the source of the ground water and its having materially increased or decreased in these later years, it is due to fluctuating climate and rainfall (1233). My opinion is that the people in the Arkansas valley in Kansas are seeking facts to explain conditions, and I wonder if they have not neglected wells that have risen and cited cases of those that have gone down. If I were going there to see I should want to examine all wells. I found some wells going up in Garden City and others going down (1234). If the level of the ground water at the city of Wichita on each side back to the foothills has gone down three or four feet within the last thirty years, I would explain by saying that by going so far eastward we would almost eliminate the Arkansas river of Colorado, and that the rainfall over a broad area which is tributary to the region around Wichita has maintained the water plane to the level which it held some time previous. If the facts are that the rainfall during the last ten years has been fully equal to the rainfall for the ten or fifteen years previous, my explanation would not necessarily fail. It is a question of the distribution of the water in the ground. And it is a very complicated matter. Any opinion I have is of very little account. I would not value it myself highly, but it is a question that I should not value the opinion of anybody else upon, unless he had examined those conditions very elaborately, and so far as I know nobody has (1235). I have sounded wells that were said to be low and found they were higher than they had been before, and *vice versa*. I find that the average farmer—nearly all farmers get a notion fixed in their heads and they collect those facts that support it and neglect those that do not, and I should be inclined to doubt such evidence, because where a well is far back from the river and is high above it it is one of those things that is so obvious that I should take it for granted that the person is mistaken (1239). Below Dodge City and on down below Hutchinson where the valley gets fifteen miles wide, I have no doubt but that the oscillation of the river might affect the level of the water on either side in a very important way (1240). The underground water is a great mass of water moving as a mass, but irregularly moving, and it moves under these valleys, and it can not be said that any one of them has an underflow peculiar to itself. The whole plains have an underflow, and on the surface of the plains rivers run, and they do not always run in just the same direction that ground waters move in. The water under the river bed has no swifter motion or slower motion

than the water elsewhere. As to the water in wells clearing from the upper side, I went into that question at Garden City. It was stated there that the material cleared from one side to the other. I used sawdust upon a large open well and found either that it did not clear at all or cleared as much one way as the other (1241). I tried other experiments on wells there with the same result. There is no doubt about the current, but it is not fast enough to show (1242). Witness said that the experiments made by Dr. Adams at Wichita where he sank five holes, one at each corner of a space of ground and one in the center, and placed pumps in each of the corners and then dropped aniline in the center hole, was good evidence of the current beneath the ground (1242, 1243). If the ditches in Colorado are not constructed so as to take the flood flow, but are so constructed as to take the normal flow out of the flood-flow season, then these ditches do take the water and influence the valley below by so much as they subtract the water from the river (1244). The taking out of the flow of the river during the normal season in Colorado shortens the flow of the river on the surface of the ground waters. This does not influence the flow of the ground water one way or the other. Nobody could be affected east of Garden City by taking out water above Garden City (1245). If the testimony of the early settlers that the Arkansas river used to flow all the year around to and beyond Garden City and to Dodge City is correct, then I am mistaken, but I still very much doubt that there is any evidence that is satisfactory that can be obtained that the river nearly every year flowed constantly past Garden City. I doubt that very much indeed. If the early river used to run in such a way as to have that June rise, it must have an immediate effect to the eastward of Dodge City (1246).

On cross-examination, by counsel for Colorado, witness stated, among other things, in effect (1246):

Went up the river as far as Canon City and down as far as Hutchinson. Garden City was selected as a type locality for the purpose of making investigations (1146), because there were many wells there. Also at that place it was a type of that kind of stream. It was midway between the point where the Colorado Arkansas river ends and the Kansas Arkansas river begins (1247).

Colorado's exhibit No. 23, being the map showing the high plains of Kansas and Colorado, including the Arkansas river, witness says was made by him.

The dotted lines on the river from about the Colorado boundary to about Dodge City indicate that (1248), in my opinion, the river is most of the year dry through that distance. Do not think those dotted lines very approximately designate the points at which the river is normally dry. Have simply expressed there roughly the fact that there is quite a wide belt over which the river normally does not flow (1249).

So long as they do not take out the flood flow in Colorado for irrigation, it will have no effect east of Dodge City. It is only the flood flow that goes through Kansas to Dodge City (1250).

There are quite a number of western streams that are affected in the same way as the Arkansas river. Among them the Humboldt river in Nevada (1250). It sometimes runs through to Carson

Sink, which is an evaporating pan. When it does not go through that sink it fails on the desert. If we dig into its plane, we find water there. It is a good example of a river that flows so long without contribution that it loses of its substance to the atmosphere by evaporation. There is another river of a similar character in Old Mexico, the name of which I have forgotten. It very rarely reaches the sea, which is only 75 miles away. It fails by evaporation almost wholly. The Colorado does not fail completely. The Cimarron river, which runs parallel with the Arkansas, is a fine example of that kind of a stream. Normally it disappears, leaving a broad belt that is without a stream (1251). The Cimarron river is typical of the class of rivers to which the Arkansas belongs (1252). The wells that respond more quickly to the rise and fall of the water in the river, in my opinion, penetrate gravel courses of easy communication (1253).

In reference to that instance spoken of by counsel for Kansas in regard to the sinking of four wells at Wichita within a square of about twenty feet and the placing of pumps at the four corners of the square and the insertion of aniline dye in the center pump and its appearance in one of those holes sooner than in the others, I will say I didn't understand there were pumps at these corners. I thought they were merely gauge wells (1253). If one pump happened to be manned by a better pumper and worked more rapidly, naturally that would attract the dye to that point first. When I was interrogated on this point by counsel for Kansas I did not understand they were pumping. I thought the water was still. The test thus made would seem to have no value one way or the other (1254).

On recross-examination by counsel for Kansas (1255) witness said, in effect:

In regard to the aniline test at Wichita, it seems to me you are applying a test that is going to be misleading. It is going to be too delicate a thing. You could not test the spring of a watch with a coarse device.

On recross-examination by counsel for Colorado, witness stated, in effect (1256):

That the ground water may properly be called percolating water as distinguished from water running in underground channels, say in limestone regions that have dissolved, and that the movement of percolating water would be a great deal greater than the movement of ground water proper.

N. H. Darton, on direct examination (1256) stated, among other things, in effect:

Have been connected with the Geological Survey since 1886. Have been studying along geological lines. For eight years last passed have made investigations in regard to the subject of underground or sheet waters of the Great Plains of the arid regions of this country. As a result of those investigations, will say that the Great Plains are covered by gravels and sands which contain sheet water. Am preparing a report on the underground water in the Arkansas valley in Colorado. Have made few observations in Kansas. The source of the underground water along the Arkansas river is the rainfall and the melting snows. Only in very small measure is it fed by the streams which flow through the arid regions upon the plains.

On cross-examination by counsel for Kansas (1257) witness stated, among other things, in effect:

That the melting snows in the mountains are an important feature of the flowing water in the Arkansas River through eastern Colorado.

On cross-examination by counsel for Colorado witness stated, among other things, in effect (1257):

Have recently made an investigation of the Arkansas river in the western portion of Kansas, in the vicinity of Syracuse and Coolidge. The ground water in that vicinity is due mainly to the water that flows on the slopes and not from the river. Within a few rods from the river a small amount of water percolates towards the ground water. The movement of the ground water is, in a measure, with the river and toward the river. The ground water supplies water to the river as a whole (1257). I would think it possible that the upper fraction of the river would have no effect whatever on the lower fraction (1258).

F. H. Newell, on direct examination by counsel for intervenor, stated, among other things, in effect (1265):

Chief engineer of the Reclamation Service of the Geological Survey. Been connected with the Survey since October, 1888. Began investigations in regard to sheet water in the arid plains. Details were gradually turned over to assistants. The investigations made by Willard D. Johnson, who has just testified, were made under my direction. The sheet or underground waters in the arid part of the United States are similar to those throughout the world (1265). This underground or sheet water extends under the valley of the Arkansas river as a part of the general sheet water underlying the entire plains area. Have made investigations with respect to the underground water along the Arkansas river in Colorado and Kansas. As a rule, it is supplied mostly largely from local rainfall. This is shown by the fact that the great body of the sheet water is at a higher level than the level of the river as a rule. Have personally visited the Arkansas river at various times from its headwaters to below Wichita. Have directed the movements of field parties and have visited them at intervals. The investigations have not been completed. Professor Charles S. Slichter, who is connected with the State University of Wisconsin, is at the present time making investigations. I heard most of the testimony of Willard D. Johnson in this case. I am substantially in accord with him in regard to there being two Arkansas rivers, although he emphasized a little more strongly than I should the fading out of the upper river. There is a perennial river above, an intermittent river below, and then a perennial river still lower down. Whenever the upper river was in flood and there was a considerable flood flow the diversion of the upper waters would undoubtedly have an appreciable effect on the lower river. When the river was at its lowest stage and it was possible that its waters would entirely disappear before getting down to the vicinity of Garden City, presumably there would be very little effect from taking it out entirely in Colorado (1266).

On cross-examination by counsel for Kansas witness stated, among other things, in effect (1275):

That if the evidence shows that the Arkansas river above the mouth of the Little Arkansas has become practically a dry stream, it might be explained in this way: There is apparently a progressive desicca-

tion of all rivers and lakes throughout the arid and semiarid region, and the disappearance of thousands of small bodies of water in the Dakotas, Nebraska, and south in Texas, due, presumably (1275), to a small climatic swing and a more thorough cultivation of the soil, causing the water to sink underground instead of running off the surface. If the waters of the Smoky Hill and Solomon have not decreased and the water underneath the soil in the valley of said river in Kansas has not gone down and the level of the water in the Arkansas valley has gone down, then I would say, if that is a fact, there must have been a different cause operating along the Arkansas river than on the Smoky Hill and Solomon rivers. If the level of the underflow in the Arkansas valley has gone down from three to five feet from the western line of the State to Wichita within the last twelve or fourteen years, would say that if that water level is and was above the river the lowering was the result of climatic conditions. If the water level in the underground was below the level of the river, then such lowering was probably connected with modifications of the river itself (1276). If the water in the river has decreased since 1890, this would not in my opinion have any effect upon the underground waters except in the immediate vicinity of the river. The regular flow of the river tends to reinforce the underflow or ground water in the immediate vicinity of the river (1277).

On cross-examination by counsel for Colorado, witness stated, among other things, in effect (1278):

Willard D. Johnson was put in charge of the work to which he has testified because of his qualification and fitness for that particular work. I use the word "underflow" simply as a popular word which has been applied to ground waters in the arid region. So far as I am aware, there is no line of demarcation (1278) between the ground water throughout the plains area and that occurring in the valley of the Arkansas river (1279). The general movement of the ground water in the Arkansas valley is with the river and towards the river in a general way. As a rule it is believed that the ground water augments the river and that only in times of flood is there any noticeable contribution from the ground water towards the river. When the river is in flood it raises the general level and that water percolates outward on a gently decreasing grade to raise the level of the ground water. It would be the general effect that the river in flood time acts as a dam or barrier and backs up the ground water which is proceeding towards the river. There is believed to be a place in the Arkansas valley where there is seepage away from the valley, as there is on the south side of the South Platte. There are rivers or perennial streams heading to the south at both of those rivers that may draw and probably do draw a small amount of water by diagonal seepage from those valleys. They lie only a few miles south from the Arkansas river. The rivers flowing south head immediately against the valley of the Arkansas and against the valley of the Platte (1279). My observations and study in reference to all of the rivers in the arid and semi-arid regions which have been settled up within the last twenty-five years have led me to believe that there apparently has been a somewhat general decrease of the available water supply, as shown by the abandonment of water power and the drying up of lakes and streams which were utilized by the earlier settlers. The most noticeable cases that I think of are in the Dakotas east of the

Missouri river. In Nebraska it is reported that streams have decreased in flow. In the Middle and Eastern States there has been a very decided change in the behavior of rivers during the last twenty-five or thirty years, due to the cutting of forests and possibly to other causes. The cutting of the forests increases the violence of the floods and reduces the summer flow. The cultivation of the soil has a marked effect on rivers in modifying the amount of water that reaches them immediately after a rain storm. It may soak into the ground and reinforce the underflow or underground waters. The digging of ditches and the construction of roadways, on the contrary, may bring the water into the river more rapidly. So that it is hard to generalize (1280). We have an irrigation prospect in view near Garden City dependent upon pumping the underground water (1270, 1281, 1282), based upon the assumption that we will always have an adequate supply of water (1277).

As to the effect upon the flow of the Arkansas river as far down as Wichita and Oklahoma, aside from the use of the flood waters, by the use of water for irrigation in Colorado I think there is undoubtedly some deleterious influence in Kansas; that is to say, the river ceases to flow farther west than it would if there was no water used in Colorado. I think the use of the water in Colorado would have a tendency to affect the stream as far down as Wichita or in Oklahoma and to cause it to cease a little sooner, but as to the degree of tendency it would be very difficult to tell, and as to the extent of the influence during the ordinary flow of the stream, I do not think there is enough water gets across that intermittent strip during the ordinary low stages of the river to have any appreciable effect on the lower part of the river (1282). Percolating waters, as I use that term, are the waters which progress toward the line of least resistance through gravels or sands or other pervious strata. The ground water is percolating water. There is no possibility of defining its boundaries except as they are coincident with the lines of gravel or clay. The direction of its flow follows the line of least resistance, which is modified by the descent or porosity of the material (1284).

On recross-examination by counsel for Colorado witness further testified, in substance:

In geological ages the Arkansas river has been simply a shifting stream which at various times has traversed a vast extent of plains region. Its present place is merely accidental and transitory. The valley of the river shows very clearly for ages a shifting stream, running first in one place and then in another (1287).

Charles S. Slichter. Direct examination (1334):

Reside at Madison, Wisconsin; 41 years of age. Hold the chair of applied mathematics in the Engineering College of the University of Wisconsin. Have had this position for nineteen years. Consulting engineer for the United States Geological Survey since 1892. Have had charge of work relating to underground waters during all that time generally throughout the country. Made investigations in the valley of the Arkansas river and the valley of the Cimarron river in Kansas and Oklahoma. Have also made investigations in California, on Long Island, and in Wisconsin. Since 1896 have spent most of the summer months in the field. Have supplemented the

field work with investigations and other studies and treatises on the subject of underground waters. In 1901 spent about a month in the Arkansas valley near Dodge City and Garden City, most of it near Garden City (1334). Made investigations in and around Garden City in the season of 1904, the object of which was to determine whether it would be practicable to recover ground water under the reclamation act for the irrigation of lands adjacent to the river. It was necessary to determine the amount and availability of the ground-water supply. Found underground or sheet water in the vicinity of Garden City. The investigation stopped at Hartland, about twenty-six miles west of Garden City. First sought to determine the velocity of the ground water if moving and the probable extent of the underground stream. In determining the level of the ground water made observations in wells already dug and in other wells that we sank ourselves. We sank about 175 to 200 wells in 1904. There were about 75 there already. The wells we put down were in the first and second bottoms. A few were put on the uplands and a few on the hills south of the river. We put the wells on each side of the river. There were wells already there on each side. The farthest well on the north side was eight and one-half miles from the channel of the river in a direct line. On the south side the farthest well we put down was two miles south of the channel. The farthest well we made use of on the north side was ten miles from the channel. We put a number of wells in the channel of the river. A great many of the wells were put down in groups, for the purpose of making measurements of the underflow (1335). "It was our object to make three principal cross-sections covering the area where we expected to recover the underground water for irrigation purposes. We found ground water there and it had a motion in every instance. It was flowing generally toward the east, corresponding generally with the main trend of the Arkansas river valley. The rate of movement varied in different places with the coarseness of the material. The average rate of all the measurements * * * was about eight feet in twenty-four hours. * * * In the wells near the river channel we were able to detect fluctuations in the level of the ground water. * * * The greatest fluctuation occurred in the wells that were very close to the river. The most remote well at which we noted fluctuations was 900 feet from the river on the north side. We concluded from our investigations that the major portion of the ground water came from the rainfall on the land north and south of the river (1336). * * *

"At our first principal station, two miles west of Garden City, in the area included by the river channel and a line 2,500 feet north of the river, a little over two-thirds of the additions to the ground water was contributed by the rainfall and a little less than one-third contributed by the floods in the river, if the time be made to include a period of flood. So that makes a maximum contribution in that time from the flood, comparing the flood with the rainfall; that is, the maximum contribution from the flood was one-third in that strip 2,500 feet wide and extending along the river channel.

"Q. Now, I wish you would give your reasons in detail as to why you concluded that the underground or sheet water derived its main supply from the rainfall and not from the stream itself. (Objection by complainant.)

"A. In order to determine the relative amount of water contributed by the rainfall and by flood waters in the river, we placed test wells at various distances from the Arkansas river at our camp No. 1, two miles west of Garden City. The first test well is four hundred feet north of the river, and another test well is 1,120 feet north of the river, and still another 2,520 feet north of the river. Observations of the level of the water in the Arkansas river were made at least twice daily during the period from June 18 to July 11, and frequent observations were made upon the level of the water in the test wells. A model has been constructed which shows the fluctuating position of the ground water in the test wells near the river and the varying height of the water in the river, and the official record of the rainfall at Garden City on June 18 and July 11, 1904. A photograph of this model is presented as fig. 1. The model referred to shows the fluctuations of the river and the fluctuation of these wells during the period of June 18, 1904, and July 11, 1904. I made a photograph of that model." (1336–1337).

The photograph of this model was introduced in evidence as intervenor's Exhibit No. 3, a copy of which is inserted at the end of this witness's testimony in connection with Exhibits 5 and 6 of intervenor.

"This photograph shows that the river and the water in the test wells remained stationary from 7 p. m. of June 18, 1904, to 7 p. m. of June 21, 1904. The four threads on that photograph represent the level of the water. The highest thread in the photograph represents the level of the water in the Arkansas river. The thread next lower on the diagram represents the level of the water in the well four hundred feet from the north bank of the river. The next lower thread represents the level of the water in the test well 1,120 feet north of the river. The thread nearest to the observer, in the protograph (Intervenor's Ex. 3), represents the level of the ground water in the well 2,500 feet from the north bank of the river. The scale of distances is shown in the cardboard nearest to the observer. The black marks on that checkered part of the photograph represent the official record of the rainfall as taken by the observer at Garden City between June 18 and July 11, 1904. The different elevations on the first thread referred to by me indicate the changes in the level of the water in the Arkansas river. The second thread represents the fluctuations of the water level in the test well 400 feet north of the river, and the third thread represents the fluctuations in the level of the water in the well 1,100 feet from the river, while the fourth represents similar fluctuations of the water in the well 2,500 feet from the river (1337).

"From this photograph you can observe the effect of the rainfall and of the flood in the river upon the level of the water in the distance covered. From the photograph it can be observed that there was no material change in the level of the water in the river or in any of the test wells from 7 p. m. of June 18 to 7 p. m. of June 21. It can be observed that on the night of June 21 a heavy rain of nearly one inch fell. The next morning observations in the test wells 400 feet from the river and 1,100 feet from the river showed a marked rise in the level of the water, as indicated in the photograph (Intervenor's Ex. 3). The level of the water in the Arkansas river remained stationary until 3 p. m. of June 22, when a sudden flood

swept down the river. In spite of this flood in the river, the water level fell during the period of flood in the test well 1,100 feet from the river; in the well located 400 feet from the river a slight rise of the water level is noticed, amounting to .1 foot. Following this, the ground water fell in both of the test wells nearest the river. The level of the water in the river remained substantially stationary from June 23 to July 11. The ground water reached its lowest position about July 3 (1337). On the night of July 3 and on the nights of July 6 and 7 heavy rains fell. An inch fell on the night of the 3rd of July, over half an inch on the night of the 6th and about an inch and a quarter on the night of July 7th. The effect of these rains was to raise materially the level of the ground water in all of the test wells, the rise in the test well 400 feet from the river being greater than the previous rise observed in the same well due to the combined effect of a single rain and a flood in the river. These rainfalls had no influence upon the level of the water in the river. The test well 2,500 feet from the river shows slight changes in elevation, due to the rainfall, but a rise follows the rain by a considerable length of time.

"In connection with the heavy rain of the night of June 21, careful observations were made on the second bottoms and uplands north of the river to determine whether or not any of the rainfall ran off the surface of the ground into the Arkansas river or whether the same was absorbed by the soil. On June 22 I drove for about twenty-eight miles over the uplands and second bottoms, seeking evidence of the influence of the rainfall. The only indications of erosion or running water or standing water were found in the highways, in many of which water had collected in the ruts, and the roads were muddy. Upon the native grasses of the uplands no standing water was found. Apparently the entire rainfall had been taken up by the soil. The amount of that rainfall is one inch. Observations were made on the same trip in pits or dug wells which were not lined with masonry or boards, in which the increasing moisture due to the rain could be observed percolating through the sod and soil of the uplands.

"The upright piece marked 'feet' on the photograph represents the vertical scale which was used in constructing the model from which the photograph was taken. Each particular division represents one foot, which is subdivided into tenths of feet. The highest flood that was reached by it was 4.7 feet from the bottom.

"Chemical tests of the waters in all of the test wells at various depths were made in the field, and, at frequent intervals, of the water in the Arkansas river. At the point two miles west of Garden City the water in the river varied from 73 to 93 parts per hundred thousand of undissolved solids. The water in the sand hills south of the river is very much softer, and the ground waters north of the river continued to get softer with the distance from the river, and also the water got softer in a marked degree with increasing depth from which it was taken and softer than the ground water first mentioned. You have to go some distance from the river before the water becomes as soft as the river water. Observations taken at Sherlock, seven miles west of Garden, were very numerous and showed a marked contribution to the underflow from the soft water from the sand-hill district south of the river, where the soft water from the sand hills is observed to be pushing north the strong waters normally found under the first bottoms (1338). The strongest water at this

point was found under the first bottoms, and the strength of the ground water was 107 parts per hundred thousand total dissolved solids. The river water at the same time contains 74 parts per hundred thousand of total dissolved solids. I have made a tabulation of a large number of these tests, tabulating the analyses first by distances from the channel, classifying them as first bottom, second bottom, and upland wells. The waters thus classified show a marked decrease in total dissolved solids as we recede from the river valley. A like classification, with the depth, of a large number, sometimes shows a similar decrease in total dissolved solids, with the depth from which the same is taken, the various waters passing into each other by imperceptible changes.

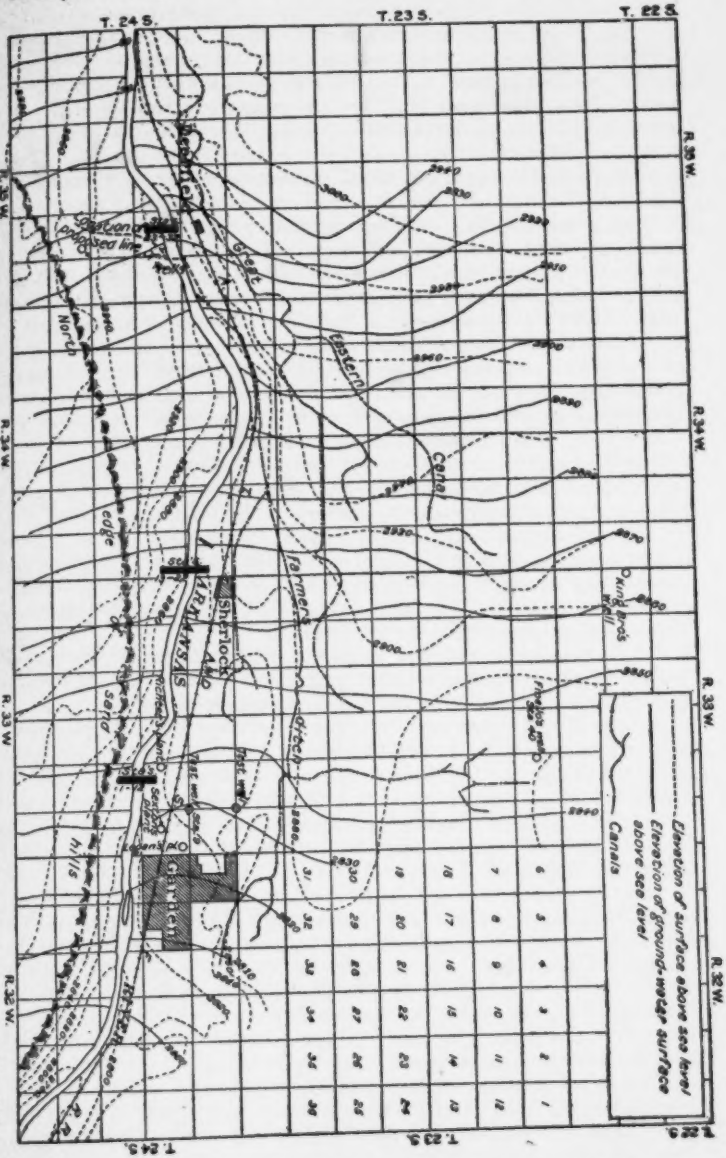
"Yes, the analyses of the water which I made at these different places is another indication which convinces me that the main source of supply of the ground water is the rainfall and not the stream itself. The other reasons that are especially pertinent in this connection is the conclusion that must be drawn from the slope of the ground-water plane as determined from the levels which we ran. A map has been prepared showing the slope of the water plane north and south of the river. It is observed to slope toward the east at an almost uniform rate of about 7½ feet to the mile, and the river channel itself has a very slight influence upon this sloping of the water sheet. At many places the position of the river could not be located from the map of the water plane if its position was not known from other reasons (1339). I have this map with me."

Said map was introduced in evidence as Intervenor's Exhibit No. 4, and a copy of the same in a reduced form appears at page 125.

"The blueprint is intended to show by contour lines the slope of the ground water; the heavy curve lines running nearly north and south represent places where the ground water is at the same height on the contour lines as marked with the elevation of the ground water above mean sea level. With some fluctuations, it shows that the ground water from the sand hills slopes toward the valley at an average slope of about 2 to 2½ feet to the mile, and indicates also a tendency for the ground water to slope toward the river from the north; but as a distance of 9 to 10 miles north of the river is reached the water plane slopes gently to the north, toward the valley of the White Woman creek, these north-and-south slopes in all cases having the average value of about 2 or 2½ feet to the mile, the easterly slope being almost uniformly 7½ feet to the mile.

"In regard to the question as to whether the taking out of water from the Arkansas river in Colorado has decreased or perceptibly affected the flow of the underground or sheet waters, I have no direct information in regard to any changes that have taken place in regard to the perennial flow of the stream. Granting that the stream should flow at high water all the time in the future, bank full, continuously (1339), changes in the ground water that I can see could be brought about would consist in a possible elevation of the ground water in the narrow strip which we have observed is subject to the influence of floods in the river. That strip is less than 1,100 feet at the first station, two miles west of Garden, is slightly in excess of 900 feet at Sherlock, and is less than 1,100 feet at Deerfield. This last point I have not given testimony on as yet. Yes; that narrow strip is only affected in times of flood water. If the river should run forever

bank full and raise the level of the ground water as high as possible, it is easy to compute that the added amount to the ground water



(1) Map showing the water plane or ground-water surface between Garden and Deerfield, Kans., as determined during the summer of 1904. Under flow stations shown west of Garden, and near Sherlock and Deerfield, Kans.

INTERVENOR'S EXHIBIT No. 4.

would amount to about one-half of a cubic foot of water per second around Garden City. It is not a necessary conclusion that if it appears that this underground or sheet water in and around Garden

City has gone down or become lower within the last fifteen or twenty years it could be attributed to the taking out of the waters of the river in Colorado for irrigation purposes. If the ground water has lowered it is not necessary to conclude that. As I have observed, the similar lowering of the ground water took place in so many other places following the settlement of the country that I do not feel justified in concluding that such a cause was necessary or pertinent. I have especially observed the lowering of the water plane in similar tests in South Dakota, where I have been familiar with the prairies before they were opened to settlement until six or seven years ago. During that time I have observed the lake beds in many cases disappear and dry up, and the ground-water level is shown by dug wells to lower with the settlement of the country, the building of roads, the plowing up of the land, the cutting of the grass and other changes that man has made in making use of the country and changing it from its natural condition. In Wisconsin, in my own county of Dane, there were a great many small lakes or ponds that were meandered in the original survey of that country, some of these ponds containing several hundred or a thousand acres, which have now entirely disappeared and the land in their former beds has been cultivated and put to use. There are a great many ways in which the changes that are brought about in the settlement of the country can affect that. In some places the evaporation from the ground is greatly increased by cultivation or by changing the natural condition of the vegetation that already exists. Every furrow of a plow and every public highway and every railroad forms an artificial drainage line along which the precipitation may erode a channel and collect in low places, and hence interfere with the normal way in which the water enters the ground or the streams.

"I have made investigations to ascertain whether or not there was sufficient ground water to justify the Government in putting in pumping plants to raise it to the surface for irrigation purposes around Garden City. I prepared the plans of a project which proposes to take the ground waters near Deerfield and recover them by wells and put them upon the uplands (1340). I have estimated that it is practicable to recover at that place 100 second-feet of ground water for a period of 150 days during each year. The strip that it is necessary to use for such purpose must be 24,000 feet in length, in order to recover that amount of water with a depth of 300 feet—300 by 24,000 is the cross section of the underflow which it is proposed to intercept for that purpose, allowing, however, a considerable factor of safety in that estimate. This 100 second-feet of water pumped for 150 days to the surface will irrigate 15,000 acres in that country. At Garden City, seven miles below, we expect no effect upon the ground waters from the recovery at Deerfield. The plans were especially made to reduce such changes to a minimum. It would have no perceptible effect below Garden City" (1131).

Cross-examination on behalf of complainant:

"I did not take all of the original measurements myself, no, sir. I took very few myself, but they were all made by my own party, excepting those of the rainfall, which was measured by the volunteer.

"The well farthest north that was put down by our men was 8½ miles north of the river and two miles west from Garden City and was on the west line of section 2, township 23 south, range 33 west. It is

eleven miles from Garden City. The farthest well that we sank ourselves was at the edge of the sand hills about two miles south of the river. We found a current to the ground water in all of the wells that were put down, and the average current was eight feet per day. The maximum velocity of this current was 22.9 feet at Sherlock, 700 feet north of the river, 7 miles west of Garden City and at a depth of 28 feet. The minimum velocity of this current was at Deerfield, being 1¼ feet in twenty-four hours, 1,800 feet south of the river, at a depth of 21 feet.

"The flood that we measured came down the river on June 22, 1904, and lasted a little over two days. The rise of the water level in the well 400 feet north of the river was noticed three hours after the flood. We noticed no rise from this flood in the well 1,120 feet north of the river. It fell continuously until July 5.

"Q. Then how much of a rise in that well did you notice?

"A. A total rise of about 19 inches.

"There was no rise noticed in the well 2,500 feet north of the river due to the flood of June 22. The rise in the well 400 feet north of the river following the flood of June 22 amounted to .1 of a foot. It then began to fall immediately. The rise in the well 400 feet north of the river due to the flood remained for about 48 hours—probably a little less. The rise in that well lasted about as long as the flood, yes, sir. Of course the flood is a diminishing flood. The well 400 feet north of the river reached its height three hours after the flood reached its height (1341).

"The rain of July 3, 4, and to July 7 (1341) extended over the area as far as we were investigating. We caught those same rains at our camp and measured them. Those rains did not have any perceptible effect upon the rise of the water in the river. Those rains from July 3 to 7 amounted to three inches, and these rains did have an effect upon the wells back from the river. It is hard to give an answer as to how soon after the rain the effect was noticed in the 400-foot well, because we observed these wells at 6 o'clock in the morning when the rains were over and we found them high. The rains were during the night. Practically every rain we had was between 6 p. m. and 6 a. m., near midnight, all of these rains, and next morning we found the changes that have been testified to. The rise in the 400-foot well due to this rainfall amounted to .8 of a foot. There was no flood in the river at all. The rise due to this rainfall in the 1,120-foot well was 1.3 feet, and in the 2,500 foot well it was .1 of a foot at that time, but during that very time we ran a gasoline engine at the 2,500-foot well on a pumping test. I don't know whether that is the true amount or not. We made two ten-hour tests on the pumping plant at that time, because it was raining and we could call in our field party for that purpose. Yes, sir; the 400-foot well began to rise within three hours of the beginning of the flood in the river. As to how I account for that, I will answer that that is a very common fact. The ground water wave is changed very rapidly by any changed pressure at any place. The wave is transmitted with a fairly high velocity, similar to the observations we frequently make where a tide in the ocean affects wells a considerable distance from it with a lag of only a few hours. The river was running all the time, you understand, quite a good stream of water, the increase over the normal height being 1.6 feet. The flood added about

20 inches above the previous level of the water. Before the flood came at that time the channel was not flooded. There was a good stream of water flowing. We did not gauge it, and I dislike to guess at the number of cubic feet per second flowing there. It was enough to trouble us so that we wanted to work on the south side of the river and we had been prevented by the flowing water in getting over there. My first man arrived there about June 7, and reported by wire to me that the river was practically dry. I arrived there, I think, about the 11th of June and found 5,000 second-feet of water flowing in the river. I don't know what the depth was at this point. There was probably about two feet of water in the river at this place. The channel of course is not level and the depth varies from side to side. We went swimming in quite a deep place in the river on the north side of the river, five or six feet deep. I should say the average depth was perhaps two feet.

"I don't know exactly where that flood of June 22, 1904, came from, following as it did the rainfall at that point by about 15 hours (1342). It was not due to the run-off in that immediate locality. There had been the rain at or near Garden City on the night of June 21, of course, that I speak of.

"The average rate of movement of the overflow being about 8 feet per day, I consider to be a higher average rate of movement than of ground water generally. The average rate of movement of ground waters, where they move at all, I would not want to put in excess of three feet in 24 hours. There are ground waters that do not move at all. I know of ground waters that have no perceptible movement. As a general thing the ground waters represent drainage and seepage, and sometimes—I will say it is an exception to find a ground-water lake rather than a ground-water flow. It is exceptional, but not at all rare. It is true, as shown by all of our measurements, that the level of the rise of the ground water was greatest near the river. If the flood of June 22, lasting two days, had lasted two months or thereabouts at practically the same height that it reached, it would probably have kept that elevation in the 400-foot well north of the river at the observed maximum height. It would retain it there. Inasmuch as I observed no influence of the flood on the well 1,120 feet from the river, I have no adequate means of judging what influence it might have had upon that well had the flood lasted the suggested two months. This flood lasted only 48 hours. If that flood had lasted two months it might have extended and influenced the ground-water level back farther from the river than the flood that lasted the 48 hours.

"I made observations at Dodge and Kinsley and Wichita. Substantially the same conditions prevailed there as at Garden City. Our observations were not as extensive. At Dodge, Kinsley and Wichita I have no observations of the changes in the water plane or the effect of floods or rains. The surface of the water level in the 400-foot well was two feet below the surface of the ground when it was low, and when it was at its highest it was one foot. The water level was two feet and eight inches below the surface of the ground at the 1,120-foot well when the water was so low, and when high two feet below. The 2,500-foot well was on the second bottom and it was ten or twelve feet from the surface of the ground to the level of

the water at that point. The changes between high and low water in the 2,500-foot well were not the same as in the other wells. It was very slight. The changes in that well amount to only one or two tenths of a foot. I can give those matters all accurately if you desire to have it so.

"Yes, sir, I think that the rain of June 21 was practically all absorbed and none run off. It is true that the condition of the ground was such at that time that a rain of that amount would practically all be absorbed in the immediate locality. We could observe no run-off into the river channel. The running waters seemed to be mostly confined to the roadways, where it had followed the roads (1343).

"As to having made some chemical tests and finding the (1343) waters back from the river a short distance nearly the same quality as the water in the river, I will say the waters surrounding the channel of the river were very much harder than the river water. After we got away from the channel of the river they began to get softer and softer, the waters being softer under the second bottoms than under the first bottoms, and under the first bottoms the water was harder than at any other place. The water under the uplands was still softer than the water under the second bottoms. I observed this to be gradual. As to the south side of the river, I was saying the difference south of the river in the sand hills is that there is an abrupt change to soft water because the sand hills begin abruptly and it is uniformly soft, deep or shallow, or far or near. When the sand hills abut on the channel of the river it is immediately noticeable within a few feet. When the sand hills are at some considerable distance the sandy bottoms on that south side have the same quality as the soft waters in the sand hills—substantially the same.

"In speaking of the strongest water being under the first bottoms, I mean that it contains a higher percentage of dissolved solids. I gave no reason why that should be true. I believe it be due largely to evaporation and to the character of the material in which the water is found. The decrease of total dissolved solids is very abrupt on the south side. Where this abruptness does not come down close to the river it is more nearly like the north side; it is abrupt in every case, I mean to say, on the south side. The abruptness begins on the sandy bottom lands on the south side, even if the sand hills are two miles distant. There is a sandy catchment area, even though flat, for two miles, and the ground waters in that sandy district are very soft and are pushing under the river toward the north. There is a very considerable contribution to the ground water from the sand hills. This characteristic decrease of total dissolved solids that was noticed as you went back from the river on both sides was noticed as you went deep toward the level of the river, and the deeper you got the greater is the decrease. It is gradual and continuous.

"Yes, sir, the river has a fall of 7½ feet to the mile through that part of the State, and the ground water has about a similar fall. On the north side there is a general tendency of the ground water to slope toward the river. In some places it is almost level on the north-and-south line. When it does slope toward the river it is about 2½ feet to the mile. There was one place where the slope was rather abrupt, about 8 feet to the mile at one point; at some points it was practically level, and that was true in the district just east of Sherlock on the

north side of the river. It was nearly level north of the river for a considerable distance. For a distance of about eight miles it is practically level. There are slight changes. Yes, sir, I found some places where the ground water sloped the other way on the north side of the river (1344). Well, we followed the ground water north in all cases until it began to slope toward the north, and as to how far we went, well, that distance changed from 10 miles to 4 miles, and gradually changed. From 10 or 12 miles to 4 miles from the river it begins to slope gently to the north. As to what caused that slope to the north, well, there is another drainage line north of the Arkansas river. The channel of the White Woman creek is to the north and the land slopes to the north.

"These comparisons that are made at the point designated in my cross-examination as two miles west of the range line between sections 32 and 33 are due north from the river at that point. I understand the 1,120-foot well from the river at that point would be 1,120 feet from this well to the river channel. The river does run east and west where our stations were located. No, there was no nearer point to the river than the 1,120-foot well, from that well. The river runs south of east and these distances were measured in that way from the river channel. I have an exact plane-table sheet, which we made, showing every curve and slough and everything else at that point from which we took those measurements. The well measuring 1,120 feet is practically at right angles from the river channel, but north in a general direction, of course. When I said that the 1,120-foot well was due north I was speaking generally and did not have that point in mind. The 2,500-foot well was that distance from the river channel at the nearest point regardless of directions.

"At that point, where the well two miles west of the range line crosses the river, the direction of the current of the underflow was 94 degrees east of north at this point, and the direction of the river channel is 100 degrees east of north. As to what that means, I will say that would be 90 degrees east of north. The average direction of the motion of ground waters, the direction of the flow, is 4 degrees south of east, and the channel of the river is ten degrees southeast. The current of the underflow is nearer straight east than the channel of the river by six degrees at this point. The slope of the level of the ground water on the south side of the river to the east is the same as it is on the north side. The slope toward the river is very uniform and about 2½ to 3 feet to the mile. As to how far back this goes, our observations did not extend very far into the sand hills, on account of the lack of wells and the difficulty in sinking wells, but it varied from 3 to 5 miles from the river. The underflow was nearly on a level with the river south of the city of Garden. At one point south of the city the slope toward the river is only about one foot to the mile. No, sir, I did not find any place on the side of the river anywhere where it slopes from the river.

"I am familiar with the article prepared by Williard D. Johnson and published in the Geological Survey. My recollection is that he has some maps that indicate that at some places the slope is from the river on the south side at distances from the river greater than we are talking about (1345). I presume we would have found places where the ground water slopes from the river on the south side if we

had pursued our investigations back farther from the river, if his observations are correct, but we were not searching for that at all. No, sir, I was not making these observations for the purpose of giving testimony in this case, but they were made for the purpose of establishing the advisability of pumping water in that valley for the purposes of irrigation, so I do not know what we might have found that would have been of value in this case if we had been able to pursue these investigations farther south of the river.

"As to the questions that if the river should flow bank full, whether the ground water in the strip I have referred to would be raised, I should say it might be raised if the river should flow bank full, because for a short distance on the north side of the river the ground water is lower than the level of the flow of the water in the river, and if the river should practically flow 2 feet deep the year round, although it might be low at some particular time of the year, this level of the ground water might be raised.

"I know nothing about how the river flowed in the earlier years prior to 1890, and I made no investigations and have never attempted to prepare myself upon the facts concerning the flow of the river prior to that year. If the river should flow practically ten months out of the year with a good, substantial flow, from one to two feet deep, I expect that flow in the river would contribute to the raising of the level of the ground water near the river. It could not exceed the increased height of the water in the river. It could not exceed, then, the contribution of about one-half of a second-foot to the underflow. I mean that if the rise of the water in the river did raise the water everywhere to the level of the water in the river the strip within which that rise could take place is so limited that the total of added underflow would amount to a continuous flow of one-half of a cubic foot of water per second of time, or 425 gallons per minute for the entire space that is below the level of the river. If the underflow should rise one foot for a number of miles down the river, it could not add more than one-half of an acre-foot per second or 225 gallons per minute in any case; otherwise it would have to flow on top of the ground. This rise could not extend back as far as a mile. If it did extend back as far as a mile, yes, it would be a third of a cubic foot over every square mile, as far as water is concerned. In other words, it would be one-third of twice as many feet as there are square feet in a square mile, because the gravels will not average over one-third of open space, and the gravels occupy about two-thirds of the volume and the water about one-third.

"I do not know anything about a lake or pond that would be right south of Garden City and between that and the river. I made no investigations of that at all. Where I spoke about ponds being dried up in Wisconsin, I was saying in Wisconsin there is no ditching, and there is no ditching in South Dakota where the drying up of the lakes has occurred. There is ditching, however, in Michigan and in Indiana (1346). I do not know anything about it in Ohio. I do not know anything about the conditions in those States as to forests having been cut off and the land being cleared there.

"Yes, sir, I stated that somewhere near two thirds of the amount of the ground water for the narrow strip which I referred to came from rainfall and about one-third from the river, and I stated that

if we could install the system that we were directly interested in I did not think it would affect the amount of water 7 miles below that at Garden City, and I think the amount that we would take out would be supplied by the original supplies of water and by the lessened evaporation. If we pumped up a thousand gallons of water 7 miles above Garden City, the original supply would immediately reinforce that thousand gallons. So I think that the taking of the water according to our plans and system for a pumping plant would not affect the level of the water more than 7 miles away.

"I made cross sections at Wichita and at those points and have several scores of analyses of the water north and south of the river at numerous points. Perhaps I have a hundred analyses of water at those points. The principal line of levels at Wichita was run just north of the city, on a township line. The range and township numbers are not given on this sheet which I have before me. On the township line extending through the north portion of the city of Wichita we found the ground water there in general sloping toward the river, with certain depressions corresponding to two creeks on the west side of the Big river and a very marked depression on the east, due to the Little Arkansas river, and east of that the water slopes toward the valley of the Little and the Big rivers. Yes, sir, there is a space in between the Little River and Big river north of Wichita where it slopes toward the Little river. At this point the strip is about a mile wide and widens toward the north and extends north four or five miles, the main river then bending to the west. I don't know whether it ceases altogether or not. It certainly must become quite inflective. But that condition exists as far as our observations went. On this township line the Little river is fourteen feet below the Big river. I have no levels north from there as to how it is. The Little river does not feed the Big river, because it is lower than the main river. I don't know how much of a contribution is made in there by the Big river to the Little river. The strip between the Big river and the Little river is—the ground water in that strip is substantially the same in character as the water in the Arkansas river for a mile or a mile and a quarter between the two rivers at this point in that strip from a chemical standpoint. The waters are substantially the same in that strip. As to what that shows, it is very strong evidence that the ground waters in that strip are being contributed to by the seepage from the Arkansas river. These direct chemical tests are restricted to three lines of observations. Here is this principal line, and there is one other line about two miles north of the first, and as to the third line (1347) the three divisions I have made are the ground waters near the principal lines of levels northeast of Wichita, and those southwest on the same line, the other side of the river, and the line below the city, downstream from the city, south of the city. Those are all. No, sir, we did not have the same conditions existing in all those different places. The ground waters are entirely different in character from the river water everywhere except in that narrow strip between the Big and the Little rivers. The Big river at this place runs enormously high in common salt, and the total solids of dissolved matter in the river water is very high, being nearly 225 parts for a hundred thousand, running especially high in common salt. It is very different from the water

of the river at Kinsley, Dodge, or anywhere else west as far as my observations have gone. The salt region practically begins about Sterling and ends some miles below Hutchinson, I think. On the west side of the river along there by Wichita the ground water slopes toward the river, about 10 feet in five miles, or 2 feet to the mile. This is on the main line of levels, west of Wichita, made at right angles to the channel of the river, above town, passing through this same township line. There are two depressions there which are not named on this map that I have, on the west side of the river. Yes, we found the old slough on the west side of the river; the Big Slough and Cowskin creek are the names of these depressions. I don't know what the direction of the current of the underflow along there by the Big Slough was. I made no measurements of the underflow there, and I cannot give the rate nor the direction. I did not make any investigations or measurements of the rate or the direction of the underflow at Kinsley, nor at Dodge, but at Dodge I made the first determinations I ever made in 1901. I found the rate there in the channel at Dodge, one determination only, to be three feet in twenty-four hours. That was made in 1901. The river had been dry then for many months. No, the river being dry does not have any effect on the rate of the underflow. When we made our measurements at Garden City last summer it was reported that the river had been dry for a great many months, including the last winter. I think there had been no water in the river since the previous fall. If the river had been absolutely dry from the State line down the river to Dodge from August, 1903, to the first part of May, 1904, I do not think that would tend to lower the underflow. There is a strip where the ground water is below the bed of the river. It usually dries out for a distance of 18 inches below the bed of the river and remains that way. If between August, 1903, and May, 1904, the river had a good, substantial flow practically all of the time, that would not have tended to raise the underflow only for a short distance back from the river. It would probably for a short distance north of the river, but not to any distance south of the river.

"As to the ditch for irrigation purposes that was dug down at Dodge and dug down into the underflow (1348), which lasted for some years, I have investigated that matter. That ditch became dry for two principal reasons. One reason was that it filled up by overflow in the river. A flood in the river overflowed and washed in a lot of mud and stuff into the natural channel, and then it would fill up of its own accord, and did fill up where it was not filled up with the wash from the river. It was filled up by an upward movement of the gravels. A so-called underflow ditch at that point was excavated some feet below the bed of the river (objection by defendants) and would have water in it if its bottom could have been held down. It would have had water in its upper end when the river was high. It could not have water in it at the lower end.

"I know nothing about the statement that when Garden City was first built the cellars were either damp or had considerable water in them. If that were true, I account for it by changes that have been made in the settlement of the country, because that ground water in the city is higher than the highest water in the river. I presume it was higher than the highest water in the river at the time the city

was built. Yes, if those cellars have since gone dry there has been some change in the level of that water. Yes, if in the city of Wichita when the city was built first in the '70's and for fifteen years afterwards the cellars could not be dug in the city because of the presence of water so near the surface that the cellars would fill with water, and that within the last ten or fifteen years that water has gone down so that anywhere in the city of Wichita you can dig a cellar and have it dry, that would indicate that the level had gone down.

"I know nothing about the rainfall throughout the whole valley not having perceptibly changed in the last thirty or forty years. I simply have the official records of the rainfall. I think the rainfall at Garden City is some five inches more than at the State line, and is about 20 inches a year for the number of years it has been measured. I know nothing about the rate of the current of the underflow at the city of Wichita or near there."

Cross-examination on behalf of defendants:

"The photograph marked Intervenor's Exhibit 3 is a photograph of a model prepared by me for the purpose of showing in graphic form the relative position of the ground water and the water in the river as affected by floods in the river and rain in the section covered by the investigations in that immediate locality to which I have referred in discussing the photograph. The top line shown by a thread strung over the cards is for the purpose of illustrating or showing the height of the water in the river from a fixed point taken as a base of measurement from day to day for a period extending from the 18th of June to the 11th of July, 1904; and the next line, or the one below that, is for the purpose of showing the level of the water in a given well sunk 400 feet north of the river during the same period (1349); and the third line illustrates the level of the water in one certain well sunk approximately north of the first well at a distance of 1,120 feet from the river; and the fourth line shows the level of the water in a certain well sunk north of the other two wells mentioned, and 2,500 feet from the river, for the same period of time as that last mentioned.

"Referring to the first line in Intervenor's Exhibit 3, when the line goes up over the higher cardboard, that shows a greater elevation of the water in the river in a flood period, and when it goes down that shows a less amount of water in the river, and the amount of increase or decrease is shown proportionately by the elevation of the line; and the same is true of each of the other lines as to the level of the water in the particular well which the line is given to represent. The card lying flat in front of the lines shows in figures the various dates opposite the upright cardboards, and the black marks on the card show a given amount of rainfall on the dates where they appear, and the amount of rainfall can be determined by the number of lines which the black marks cross, each one representing one-fifth of an inch.

"It appears from this exhibit that there was practically no effect shown in the well 2,500 feet from the river by reason of any change in the depth of the water in the river. It also appears from said exhibit that there was little if any change shown in the well 2,500 feet from the river because of any rainfall in the country. I account for the fact that the well 2,500 feet from the river shows less effect from rainfall than the wells 1,120 and 400 feet from the river because of it being a much greater depth from the surface of the ground to the

water at that place, and, in addition to that, at the rainy period we pumped heavily from that well with a gasoline engine. The photograph, as to this 2,500-foot well, as to the period of rainfall, might not show the true condition as far as the July dates are concerned. We were pumping from that well on June 15, 24, and 27 and on July 5 and 6, but I do not think this pumping would interfere with anything which might be shown by the exhibit as to the flood of the night of June 21 and 22, and so far as the flood effect upon the well 2,500 — from the river is concerned, I think Intervenor's Exhibit 3 correctly represents the facts. The well 1,120 feet from the river did not at any time show any effect from the flood in the river; in fact, the level of the water in this well 1,120 feet from the river, as shown on the exhibit, continued to fall during the period the river was under flood and for some time thereafter. The ground water does feel some influence from a rise in the river, as I have said, at a distance of 400 feet from the stream.

"Speaking generally of the river through Kansas and excluding special or peculiar spots, I would say that this ground water would show some influence from 400 to 1,000 feet from the river on account of a rise in the river (1350). That is, a thousand feet is about the distance from the river that the rise or fall of the water in the river will affect the level of the ground water. That distance is a fair maximum for western Kansas, I should say. The amount of water which would be furnished by a rise as shown in Intervenor's Exhibit 3, extending back from the river 2,500 feet—that is, a strip 2,500 feet wide—would be one-half of one cubic foot per second of time—that is, a strip 2,500 feet wide on the north side of the river, and to get this amount I estimated it on a rise of 3 feet in the river level throughout the entire distance of 2,500 feet, but, as a matter of fact, I at no time found the river making that amount of rise, even back to the 400-foot well, and I found it making no rise back as far as the 2,500-foot well; but taking that as an arbitrary distance (2,500 feet) and 3 feet as an arbitrary height to which the water should be raised, the amount of water moving through the soil for that far back and with a depth of 3 feet would furnish a flow of one-half of a cubic foot per second of time. Assuming a rise of 3 feet in the ground water level, extending back 400 feet from the bank of the river, it would furnish about one-sixth of one cubic foot per second of time. I don't know whether a rise of two feet in the level of the water in the river would cause a rise of two feet in the level of the ground water back for a distance of 400 feet or not. The tendency at the present time is for it to fall or slope off as you go back from the river. The lowest point is north of the river. I think the rise in the level of the ground water within the strip which I have said is influenced by the rise in the river is due to two causes—first, by the water proceeding from the river into the ground, and, second, because it furnishes a dam or backwater which raises the level of the water proceeding through the ground toward the river. I think both causes are present, of which the first is perhaps more marked than the other. I said that this well 400 feet from the river showed the effects of a rise in the river within about three hours. I did not mean by that to say that the water from the river proceeded through the 400 feet of soil within three hours. Such a rise can take place in per-

fectly stationary water. The increased height of the water in the river produces a pressure that is almost instantly transmitted through the water to a considerable distance, and a wave is set up in the ground water, which moves inward. It is not that the increased water in the river has gotten over to that well, but by pressure it has simply raised the water that was already there. I measured the rate of movement away from the river during that flood. I found that the rate of movement at the identical station at which it had previously been measured was about nine feet in 24 hours, and during the flood a second measurement was made, and the rate of movement was 9 feet in 24 hours, but the angle at which the flow was taking place was changed by about 43 degrees, away from the river channel rather than in the direction of the river channel. The method of the movement of this water may be fairly illustrated as follows: If you had a vessel which had two openings on opposite sides (1351), with the water extending up into that as pipes extending from the body of the vessel, and you placed something in one pipe or at one side, it would immediately make a rise in the water at the other side.

"From the chemical tests of the water which I made I found that the water in the river was softer than the water north of the river, and its temperature was very much higher, which indicated that the strong ground water was not a contribution from the softer ground water. In the second bottoms or uplands I found that the water was much softer than the water in the river; that by the time the second bottoms were reached the waters became softer and reached their greatest softness on the uplands.

"Q. Then if these waters on the second bottoms or uplands came from the river, this could not be true if they had to proceed through the first bottoms which had the harder water, could it?

"A. It could not be true.

"Speaking of the slope of the ground water as compared with the slope of the river, the slope of the ground water to the east is practically the same as that of the river—that is, it slopes with the river to the east, and it also slopes generally toward the river, not from the river. It is perfectly possible from this that the ground water might have what would be called two movements—a movement with the river and a slight movement toward the river. It is a fact that our measurements if classified with the measurements of the north side of the river—that the direction of the flow north of the river will cross the channel of the river and those taken on the south of the river to an even more marked degree will cross the channel of the river. The experiments, taken as a whole, show very slightly that the movement is with the river and toward the river. The strong indication is on the south side only. Some of the wells as we went north from the river that we investigated showed a lower level of water than the wells between those and the river. This was after we crossed the divide and were going into the drainage of the White Woman. The level of the ground water, generally speaking, has something in common with the level of the surface of the ground on the north side of the river, but it does not match it very accurately. It is true that where you find the country falling away, to the east, we will say, as the Great Plains do, we will also find the water falling away and with a movement in that direction. In the locality about Garden

City, as we proceeded back from the river to the uplands and reached the divide between the Arkansas and the White Woman, the level of the water at the divide was higher than the level of the water in the river or in the White Woman, and on one side of the divide it slopes to the east with the river and slightly toward the river, and on the other side it slopes with the general fall of the country to the east and toward the White Woman.

"Q. If it be true that the Arkansas river in its natural condition, before touched for the purposes of irrigation, was a stream which had water in it through western Kansas (1352) for only a part of the year—and there were months in practically every following year when there was no flowing water in it—then, in your judgment, would that stream under those conditions have furnished any such amount of water to the ground waters of the country through which it travelled as would be of any practical benefit for any purpose? (Objection by complainant.)

"A. I would expect under those circumstances to find the ground water under the same conditions as it is found at present; that is, so far as the river has any influene upon it. I made some investigations about Deerfield. This is a town about fourteen miles west of Garden City and seven miles west of Sherlock. I have a diagram that shows the influence of flood and rain as observed at this point, but no model or photograph. These observations at Deerfield were made from August 4 to August 11, 1904. The level of the water in the river was observed continuously, and also in three test wells. Two test wells were located 1,100 feet from the river, one of them being 1,000 feet upstream from the other. There was also a test well located 1,730 feet from the river. Three-quarters of an inch of rain fell on August 4 and one inch of rain fell on August 5. All three of the test wells showed a rise in the water plane due to this rainfall. The observed increase in the height of the water was about the same in all of the wells, and showed that at least sixty per cent of the rainfall reach the ground-water level. A flood came down the river on the afternoon of August 7. The test wells were observed very carefully during this period of flood, but no material change in the level of the water in the wells took place while the river was in flood. The test wells were observed until noon of August 10, and the river was observed until noon of August 14.

"Q. Did any of your investigations in this locality show the comparative level of the ground water and the river water as to whether one was higher than the other or not?

"A. The level of the water in the test wells was lower than that of the water in the river.

"And yet no effect was shown by the flood.

"In the various instances in which I have spoken of the level of the water in the river I refer to the surface of the running water in the river.

"Referring to the level of the ground water about Garden City, I would say that I never made any special investigation of it in that locality, but from my general knowledge of the country and the subject I do not think there is any necessary relation between the lowering of the level of the ground water in Garden City, if it has been lowered, and the river, because the level of the water in the city is

higher than that of the river, and, being higher, it could not draw its supply from the river.

"In referring to charts, I find that the water in the city is not higher than the water in the river. I was mistaken in regard to that (1353). In one part of the city it is, and in the other it is not. The same conditions which have caused the lowering of the level of the ground water over large areas of the United States might have caused the lowering in Garden City independently of the river. (Objection by complainant.) The building of sewers and the laying of sewer pipes in the drain ditches that were cut for them might in itself lower the ground-water level throughout the town if the sewers were laid below the level of the ground water.

"Q. You spoke of South Dakota and of having noticed a marked lowering of the ground-water level in that State. Was that in the immediate vicinity of the rivers or where it was uninfluenced by river conditions?

"A. It was remote from the rivers, between the valleys of the James river and Missouri river.

"And there was no irrigation in that country at all.

"The same is true as to the places observed in the State of Wisconsin where I stated there was a lowering of the level of the ground water. These places were remote from the rivers.

"We found numerous wells existing in the neighborhood of Wichita between the Arkansas river and the Little Arkansas. We did not sink any wells. From these wells we found the water level sloping from the Arkansas river to the Little river and then sloping from the Little river upward to the northeast through the city of Wichita, cutting off the drainage of the city from that of the Arkansas river. These wells that I examined were on that bit of land which might possibly be termed the delta, between the two streams, where they come together. I have no evidence one way or the other as to whether the conditions on this strip of land investigated were abnormal; that is, I do not know whether this delta at one time might have been or not the old river bed or whether the two streams might have come together at some period, farther up.

"The reason for the slope from the Big river to the Little river, of the ground water, is that the Little river has eroded a channel which, as I stated, at this point is about 14 feet deeper than the bed of the Arkansas river, and the Little river is a clear water stream while the Arkansas river is a muddy stream. Having eroded to that extent the Little river in a measure acts as a drain for the country lying between the two and draws the water, because of its being lower, from that section of ground lying between it and the Big river, and that in a measure accounts for the fact that the influence of floods, for instance, in the Big river, or of any flow of water in the Big river, extends further from the banks than it does at points farther west on the stream.

"As to the amount which a strip of land a mile wide such as you find there between the two rivers would carry in cubic feet per second of time, and assuming the same kind of soil as you have in western Kansas—which is a very generous assumption, because as you go down the stream you would expect to find the sand finer—and with a slope of 14 feet to the mile (1354), and with a depth of water

of, say three feet, each mile would furnish about two second-feet, that is, for each three feet in depth. (Objection by complainant.) I could give a better judgment as to the flow of these waters from the character of the waters and the beds of the rivers. The character of the water in the Little river is very soft; the water in the Big river is very hard; showing that the contribution is not a large per cent of its flow. It is about one-fifth of the strength of the water in the Big river.

"Q. From your investigations in western Kansas, about Garden City, could you give us any notion as to the value of the low water flow—that is, when the Arkansas is running a very small stream, as it has been testified it often does, to the ground waters? Does it have any perceptible effect on them, say when it is running a stream thirty or forty yards wide and six or eight inches deep?

"A. We have detected no influence upon the direction and flow of the ground waters during the low stage of the river.

"During the low-water flow in every case of observation—and we made several—a test hole put down in the running water showed the ground water beneath the bed of the river to be lower than that of the flowing water in the river, showing that at its low stage the bed of the river is almost impervious—silted badly with mud.

"Q. During the low-water stage does the river throughout gain any benefit from the ground waters, or is the converse true, that the ground waters gain from it?

"A. Speaking of the district which I have been discussing, from Garden City west to Hartland, I am very sure there is no contribution from the ground waters to the flow of the water in the river.

"Q. Does it contribute to the bed of the river—that is, does the water so proceed from the outlying lands toward the river that it is taken up by the sands if not by the flowing stream on the surface of the river?

"A. Very slightly that is true. It is a very minor matter.

"That is very largely because the motion to the east is so greatly in excess of the motion toward the channel. It may contribute more extensively to the river farther east, but I do not know anything about that.

"I made some investigations of ground waters west of Garden, near Sherlock, of the same character as those about which I have been testifying. Sherlock is seven miles west of Garden. From these investigations I prepared a model on the same general lines as Intervenor's Exhibit 3, except that it shows both sides of the river. Intervenor's Exhibit 5 is a photograph of a model I made, taken from the north side of the river. Intervenor's Exhibit 6 is a photograph taken of the same model as shown in the previous photograph, taken from the side that represents the district south of the river, near Sherlock, Kansas (1355). Taking these exhibits, the top of each cardboard corresponds to a cross section of the water plane taken across the valey on a certain date, the right side of each card corresponding with the north side of the valley and the left side corresponding with the south side of the valley. The location of each test well is shown by a vertical line and the position of the channel of the Arkansas river is indicated by the level segments of each cardboard near the middle of the sections. The model shows to the

eye the way in which the level of the river and the level of the water in all the test wells gradually fell from July 13 to July 27, and it also illustrates the influence of a flood of July 27 upon the wells near the river. It also shows that the level of the water in the test well one-half mile south of the river was not influenced by the flood in the river, but continued to fall during the entire period. It also shows that the flood of July 27 affected the level of the water in the test wells located 500 feet from the river and to a much less degree the level of the water in the test well located 900 feet from the river. The test well located 1,700 feet north of the river was not observed during the period covered by the photographs, but a measurement of the direction of the flow of the underflow waters immediately following the flood in the river showed that the direction of the flow was parallel with the channel of the river and was not diverted in the direction of the flood in the river. Similar determinations of the velocity of the flow in the well 900 feet from the river, made while the river was in flood, showed that the direction of the flow was slightly away from the main direction of the river channel. The direction of the underground flow is sometimes determined by the character of the material in a given direction; that is, while the general trend of the flow might be toward the east, at some given point it might vary from that on account of the less difficulty in getting through certain material that was in the natural line of flow; yes, sir; so that slight variations in the direction of the flow are not necessarily of any particular significance in determining the general movement of the whole of the ground water. A single determination is not of very great value.

"There are a great many reasons that lead me to believe that the pumping plant heretofore referred to will not affect the supply seven miles below. One of the reasons is the very favorable catchment area from which we draw. The rainfall upon a township of land in our catchment area will supply the water we take out. This is not an estimate, but an actual determination of what the rainfall contributes to our catchment area. Part of the work was to determine how much water entered the catchment area we proposed to use.

"Q. Do you know of any reason why that Dodge City ditch about which counsel for Kansas asked you would not have water to-day as it formerly had if it were in the same condition it was in when it had water?

"A. Yes. The underflow ditch at Dodge never did carry its flowing waters for any great distance (1356), because it ran over very coarse beds of gravel, of necessity, which absorbed the water at one end as fast as it could be taken out at the other. The conditions were impossible for carrying the water over that coarse material.

"Q. But as far as it formerly did have water, if it were in the same condition it was in when it was first built, ought it to have water now?

"A. It would have the same water as it had; yes.

"I have had a good deal of experience besides that which I have testified about in the Arkansas valley in determining the direction of the flow of ground waters and the rate of flow.

"Q. I want to ask you, Professor Slichter, whether a test of this kind would be of any particular value in determining either the

direction or velocity of the flow of the ground waters: If parties in Wichita sank four wells, one at each corner of a square, twenty feet apart, and then sank a well in the center of the square and put aniline dye in the center well, and then manned each corner well with a pumper and commenced to pump, and out of one well there appeared the coloring matter before out of another, would that be any safe test as to the direction of the ground flow and its velocity?

"A. As you have described it, it would be a perfectly worthless experiment as far as determining the velocity or the direction of the ground water is concerned. As I understand it, a man at each corner was pumping simultaneously at a uniform rate.

"Q. I will ask you if you have not had an opportunity and if you have not read either in the evidence or an abstract of the evidence of the experiment which was introduced by the attorneys for Kansas to show the direction of the ground-water flow in Wichita similar to the example which I have just given you in my last question? (Objection by complainant.)

"A. Yes, sir.

"Q. You said that you have read something of that kind. Do you consider that the test described in the evidence in this case which you say you have read is an adequate one for determining either the fact of flow, the direction of flow, or the velocity of the flow? (Objection by complainant.)

"A. I would not regard that as an adequate determination of any of the facts which you have stated.

"Q. Can you give some of the elements that are left out in the test as outlined in my question or as stated in the evidence which you have referred to that are lacking to make it a trustworthy test for the purposes named?

"A. Everything that would be essential to such a test is lacking in that test, because by your statement the natural level of the ground water is being disturbed by pumping, and the normal rate of movement of ground waters is slow. The artificial rate that was introduced is of necessity much higher, and the direction of least resistance between two of those wells would be taken by the aniline dye (1357), even though the direction of the flow of the undisturbed ground water was directly opposite to that. The moving ground waters average up in their motions the resistances presented by various deposits over wide areas, while with the pumping that was done in that case every little local inequality would have an enormously exaggerated influence upon the local direction of the flow.

"Q. Difference in pumps might make some difference, might it not? (Objection by complainant.)

"A. It might.

"Q. The difference in the strength or speed with which the men worked might make a difference, might it not? (Objection by complainant.)

"A. It might make a difference. It might not be nearly as great as the enormous differences that exist in every deposit of sand or gravel from foot to foot.

"My investigations about Wichita did not disclose an abundance of soft water. I did not test it for its sanitary qualities. The hardness could be accounted for by local conditions there.

"We made some investigations of a stream called Bear creek in western Kansas, near Hartland, where there is a depression, which is the dry channel of Bear creek. That stream does not flow at this point, and as far as I can determine from settlers it never has been known to flow at the point where we made the investigation. It is a stream which has not been observed to reach the Arkansas river. It has been observed to reach into the sand hills. When it reaches those sand hills, it sinks into the sand. I don't know whether the waters of Bear creek, both in normal and flood times, go to supply the ground waters of Kansas. I only know that at this point where there is this dry channel in Bear creek the direction of the flow of the ground water is in the general direction of the Arkansas river valley, and if the waters of Bear creek sink into the soil there at that place they must necessarily augment somewhat the ground waters in that locality, and they do.

"Q. You know nothing about the general flow of the Arkansas river and the effect of irrigation upon the return waters, and matters of that kind?

"A. I know nothing about those matters at all.

"The general laws of the movement of ground waters are now thoroughly well understood by investigators, and while I have been testifying in regard to particular instances and investigation, those are simply instances which fall within the general rules covering the flow of ground waters; and while the rate of flow might be greater or less in other places or localities, yet for the character of soil through which this ground water flows in western Kansas, taking into consideration the fall, the estimates which I have given are accurate determinations. They are not guess work at all.

"As we proceed farther down the stream in Kansas the slope of the ground water changes. (Objection by complainant.) We found the slope of the ground water at Wichita to be about five feet to the mile (1358); in the western part of the State it is about 7½ feet to the mile, and at Kinsley about 6½ feet to the mile, and as a general proposition the sand becomes finer and the gravel smaller as you proceed down stream from its head.

"Speaking of rainfall, the prorportionate run-off increases very rapidly as the annual rainfall of the same character increases; but to determine the increase would require a special table for each locality.

"Q. But taking the same locality or the same ground conditions, a rainfall of thirty inches per annum falling in the same manner would furnish much more than double the amount of run-off that a rainfall of 15 inches would furnish?

"A. Yes; it would under identical ground conditions—slopes and everything. It is not as simple as that by any means.

"Q. But the valley of the Arkansas in eastern Colorado and that in western Kansas and down in the middle has many characteristics in common, has it not?

"A. I think the characteristics of the intermediate region differ from both of them. The region around Garden, I think, differs quite a little from that in the eastern part of the valley and from that in the western part. I should say the differences were greater than the resemblances, so far as run-off is concerned. I think there is more run-off in Colorado. I will simply say I know there is no appreciable

run-off around Garden, from observation. As we proceed farther east in Kansas I know there must be a run-off there on account of the floods following the rains. I haven't investigated in any way. In the eastern part of the State we know that the streams are perennial and that there is run-off, on account of the indications of erosion everywhere. I know of no perennial streams in western Kansas except what we call the Cimarron; that is a perennial stream—if you call that a Kansas stream. It is partly in Oklahoma.

"Q. Could you call the Arkansas in western Kansas a perennial stream?

"A. It is a torrential stream."

Cross-examination on behalf of the complainant:

"I think I made two statements in answer to questions propounded by counsel for the State of Colorado; yes, sir; that during the flood the waters flowed at a greater angle from the river than when there was no water in the river. That is true at the stations near the river. I gave the angle of change at the station 300 feet from the river; 43 degrees difference; that is, 43 degrees farther away from the direction of the channel during the flood than when there was no flood. I think that the date of that flood was August 7th. Yes, sir; I had one well at 1,100 feet and one at 1,730 feet, both on the south side of the river (1359). There was another one 1,100 feet from the river, but 1,000 feet up stream from the other one, making a triangle. Yes, sir, the level of the water in those wells was below the river. No, sir, it did not at that point slope from those wells to the river.

"I will have to change my statement about the elevation there, because these wells were not in line, and the elevations in the river were taken at the bridge and one well was below the bridge and one above the bridge. Well, two of the wells were below and one above the bridge, so I can not state without looking at our original data the exact difference in level, and the indications are that the ground water level there is higher than the level there, and not lower. The absolute values I gave of those test wells are lower, but being down stream from the position at which the level of the river was taken, so that does not signify that they were absolutely lower. The level in the test wells was not necessarily lower than that in the river.

"In determining the level of a well from the river, yes, it depends upon the point of the river that you make the comparison with. It should be taken at right angles with the river channel. These that I have given are at right angles. Oh, yes; if any water went from any point in the river into any of these wells, it would go from the point from which you make the comparison. It would go in the direction of the slope, and that is the direction of greatest slope during a flood—these wells being near the river—more particularly in that direction than in any other. A slight variation.

"Yes; I think that in some parts of Garden City the wells are below the level of the river. The slope would be at right angles to the river channel. Some of them are lower.

"During the flood of July 27 observed at Sherlock the river increased 4.3 feet and it affected the well 500 feet south of the river and produced a change in that well of 1.4 feet, about 51 hours after the flood. The flood began at eleven o'clock in the morning. At night this

well had shown an increase of .2 of a foot—almost nothing—and the next observation we have of that well that is recorded in this table is at 8 a. m. of the 29th, and then it had risen 1.3 feet. That evening at 7 o'clock the maximum of the flood—its maximum was at 5 p. m., of the flood, that is, the maximum on the 29th. The flood began at 11 a. m. on the 27th and the observation was at 8 a. m. on the 29th. That makes 51 hours. The rise, then, reached its maximum in the well 51 hours after the flood began. I cannot tell how much it had risen in 24 hours. At 7 p. m. there was a rise of nearly .02 of a foot, 8 hours after it began. Perhaps that is pretty long, because it raised gradually, and the maximum was at 5 p. m. That is only two hours after the maximum. The rise in the 500-foot well was observed hourly during the flood. It was observed every hour and every half hour. At one o'clock p. m. there was no change. At 3 o'clock p. m. it had arisen .1 of a foot. At 5 p. m. it had risen nearly .3 of a foot and at 7 p. m. it had risen .5 of a foot (1360), and it reached its highest about 2 o'clock on the morning of the 28th; that is, we observed all through the night, hourly.

"As to the 900-foot well, at its highest it had risen .7 of a foot in about 15 hours. As to the 1,700-foot well, the direction of the flow at that point was not affected and observations of the height of the water in it were not made on account of the fact that the well was not finished when the flood came. I think the water in that well did not rise at all on account of there being no change in the direction of the flow. I do not know how long the flood of July 27th lasted, because it was still in flood when this record ends, on August 1. It had not receded completely. It was a very severe flood. It lasted more than four days, but how much more I do not know. It reached its height at 5 p. m. on the 27th. It fell very slowly.

"Q. There is a current to the underflow at the city of Wichita, is there not?

"A. There must be, because there is a slope to the water plane.

"Q. Then if the test that counsel referred to showed simply that fact, it was valuable for that purpose, was it not?

"A. If it showed the fact?

"Q. Yes.

"A. I can't conceive that it would show that fact, however.

"Q. It was not made by you, was it?

"A. No, sir.

"Q. When you speak of the Dodge City underflow ditch, you never saw that ditch until 1901, did you?

"A. No, sir.

"Q. And the ditch had then been out of existence more than 15 years, had it not?

"A. I don't know. It was filled up at the upper end when I saw it.

"Q. The ditch was dug in the early '80's, was it not?

"A. I don't know; I think so.

"Q. About 1884, was it not?

"A. I think it had been in existence a long time."

Recross-examination on behalf of defendants:

"Q. You have been asked often as to the current of this underflow. Do the ground waters through Kansas where you made your inves-

tigations have a current or flow in a channel in the way in which we speak of the current of a river or the channel of a river?

"A. Well, the flow is in gravel—in sands—and not in caverns.

"Q. Are not these waters what are commonly called percolating or ground waters?

"A. Yes.

"Q. The mere fact that they move in one general direction (1361), coincident with the general slope of the country, does not change their character from percolating waters and what is meant by that term, does it?

"A. In my opinion, it does.

"Q. In what way?

"A. They constitute a drainage for the country that passes in a general direction for long distances without seeking a surface drainage channel.

"Q. Well, I say, that does not alter the fact of their being percolating waters, does it?

"A. Well, I make a distinction between percolating waters and waters that drain a country in this way, myself.

"Q. What is the distinction that you draw?

"A. The distinction I draw is the distinction between waters that percolate towards a stream and form what we might call springs in the bed of the stream and waters that move on for considerable distances without seeking release or being forced to seek release in surface streams. I call one underflow waters and the other percolating waters.

"Q. So far as the rapidity with which they move is concerned, these ground waters move no faster than what you denominate percolating waters, if as fast, do they?

"A. No, sir, no difference in that respect.

"Q. None of these ground waters of which you have spoken are such as can be designated underground streams or water flowing in defined channels, are they?

"A. They are not.

"Q. Then at least to that extent they are percolating waters as distinguished from waters flowing in well-defined channels or streams either underneath the surface or on the surface of the ground, are they?

"A. Yes."

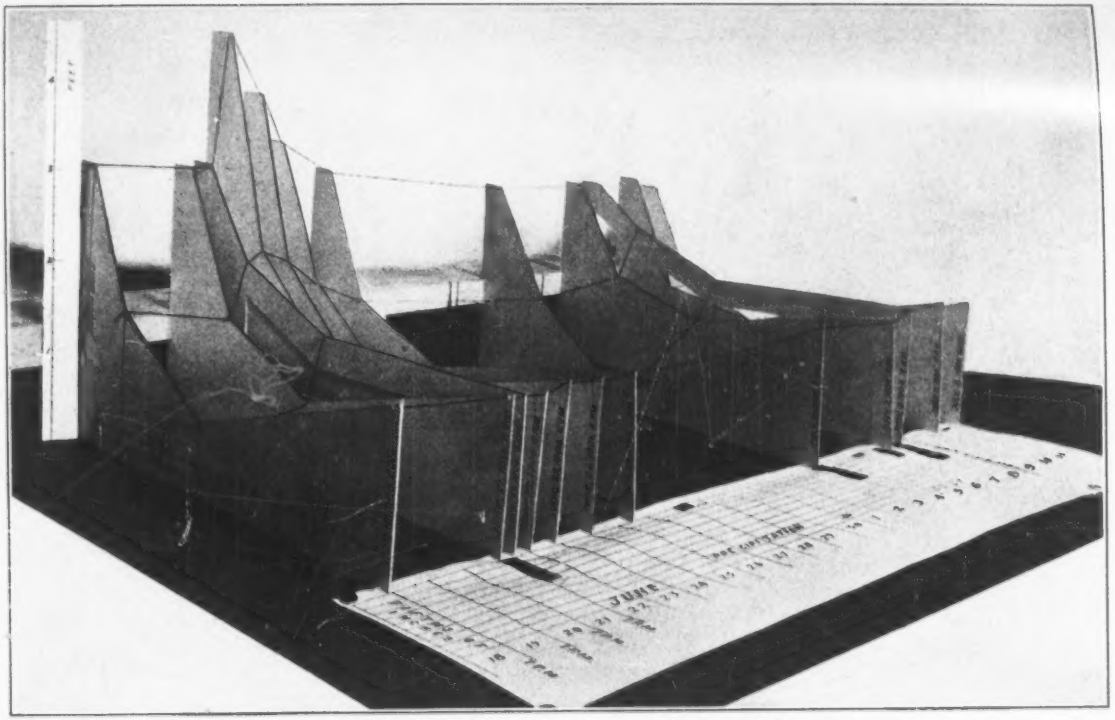
Redirect examination on behalf of intervenor:

"Intervenor's Exhibits 5 and 6 are correct photographs."

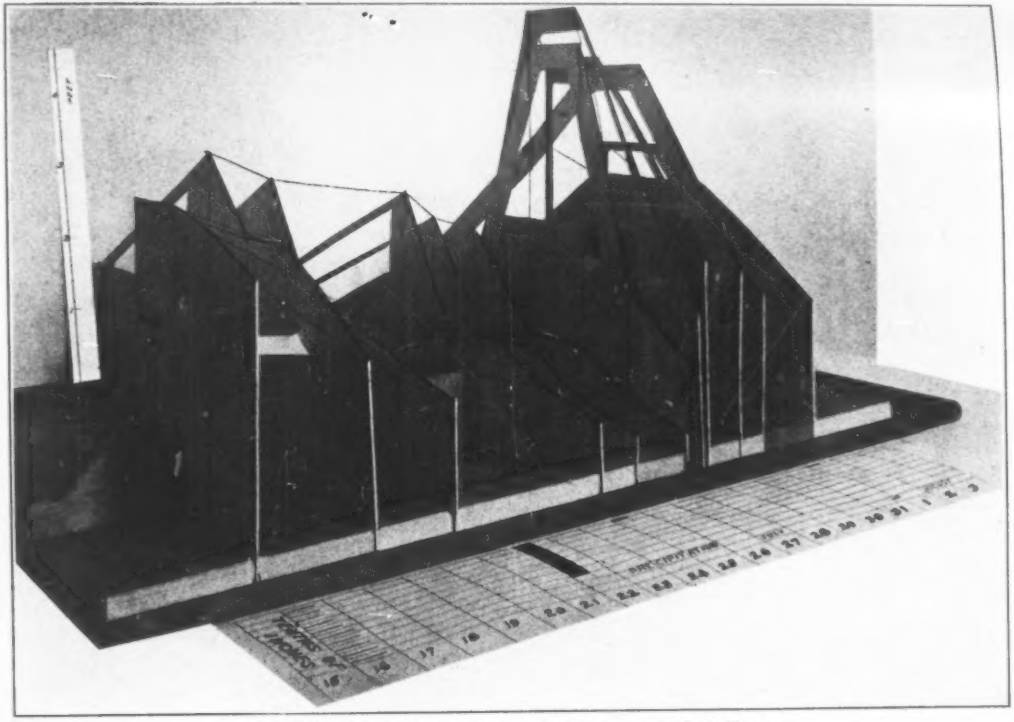
(Said exhibits were here offered in evidence.)

"The models which I have used in my testimony, of which Intervenor's Exhibits 3, 5 and 6 are photographs, are partially made of cardboard. The cardboards are mounted on a base of wood."

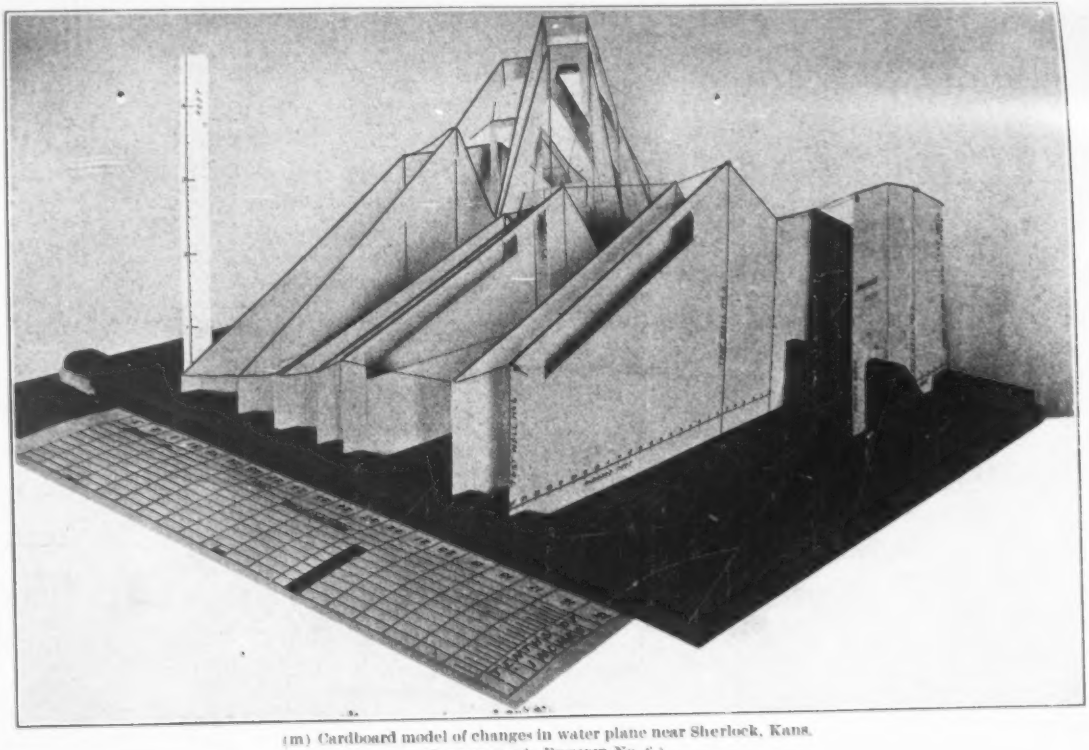
Copies of said photographs here follow:



(k) Cardboard model of changes in water plane near camp 1.
(INTERVENOR'S EXHIBIT No. 3.)



(1) Cardboard model of channages in water plane near Sherlock, Kans.
(INTERVENOR'S EXHIBIT No. 5.)



(m) Cardboard model of changes in water plane near Sherlock, Kans.
(INTERVENOR'S EXHIBIT No. 6.)

Clarence T. Johnston, State Engineer of Wyoming, said, in substance (1033):

I have made some investigations with respect to what is called the underflow in the Arkansas Valley, and from this investigation I am confident it is percolating water. I would not venture an opinion as to its source. It would be assumed from the measurements that have been made that the water does have a definite current and in a particular direction.

(6) IN RESPECT TO THE EFFECT THE SO-CALLED UNDERFLOW HAS UPON PRODUCTIVENESS OF THE SOIL OF THE RIVER VALLEY IN KANSAS; NARROWING OF ITS BED; ACCUMULATION OF ISLANDS; GROWTH OF TREES ON ISLANDS AND ALONG BANKS; ALSO IN RESPECT TO JUNE RISE.

(a) Complainant's Witnesses in Chief.

M. M. Murdock (251), of Wichita. Direct examination:

Formerly the underflow reached the roots of the corn, and thus benefited the crops, and they could raise crops whether they had rain or not (254). The corn crop is not as sure as it was fifteen years ago, for the reason that the water does not come up as near the surface as it did then (292).

John W. Harrison, of Colwich, Kans. Direct examination (273, 274):

The fall of the water in the river has affected the corn crop in two ways—we don't get this subirrigation that we did and we don't get the amount of rainfall that we did. This subirrigation has been reduced, and the fact of its having gone down has affected the productiveness of our soil. This effect has been noticed on both the first and second bottoms. The river at my place near Colwich has narrowed 627 feet within twelve years. Within the last five years it has narrowed 287 feet by actual measurement. This has been caused by the water being abstracted from the river for irrigation purposes. We began to notice the water going down after irrigation began in Colorado.

Henry Jorgenson, Mount Hope, Kans. Direct examination (279, 280):

The loss of water has not affected the wheat crop very much, but it has affected the corn crop in dry years. Wheat crop don't depend on the underflow, but the corn crop does in a dry season. The bed of the river has filled up and narrowed and trees have grown along its banks.

W. O. Huss, Mount Hope, Kans. Direct examination (282, 283):

During the first ten years from 1871 we got corn on the bottom lands without any trouble. It didn't appear to depend upon the rainfall at all. It got its moisture from below, as we claimed. During the last ten years we haven't had as good corn crops on the bottom lands as we used to have. The lowering of the underflow also affects potatoes and vegetables on the bottom lands the same as it does corn. The river banks have been narrowing during the last ten or twelve years, but I never noticed any narrowing the first ten years. The river bed is filled up in places with sand, and there is grass and trees growing on it. There are trees there now that were not there twenty years ago. The islands are becoming larger and more of them. A crop of corn, potatoes, and vegetables don't equal what it used to be and not as certain as formerly.

C. E. Tupper, Mount Hope, Kans. Direct examination (284, 285):

River not nearly as wide as it was in the seventies. Trees and grass growing where river used to run. Islands getting larger and more permanent. Lowering of the underflow has affected all crops to some extent, but principally corn. Corn crop used to be more certain. Now depends upon rainfall.

Cross-examination by counsel for Colorado (285):

My average corn crop for the last twelve or fifteen years has been about thirty-five bushels to the acre. The market value of the land is probably more now than formerly.

H. H. Hansen, Wichita. Dirent examination (286, 287):

Within the last fifteen years channel of the river has narrowed one-half. When the river is most of the time dry, weeds and grass and trees will start and the sediment of the river will accumulate and fill it up (287).

"According to my observations the productiveness, by reason of the subsidence of the underflow, has decreased not less than thirty-five per cent, and that condition extends all over the bottom so far as I know it (289)."

Cross-examination by counsel for Colorado (289):

No trees here when I first came, in 1870, except some cottonwoods here and there on the river. I have raised corn every year since I have been here. Corn has been my principal crop. It continued about the same until about 1890 (289). Have planted this same land to corn since 1870 to the present time. Have never fertilized it (290). The June flood is not as high as it used to be. Sometimes we don't know whether we've got the June flood or not (292).

D. E. Breese, Wichita. Direct examination (293, 294):

The effect of the fall in the underflow on growing crops on my farms has been a depreciation of at least one-third. In the early days when the river was high the ground would be perfectly moist underneath. This existed from the time I first came to the place—1878—until about 1889 or 1890. The farmers now to raise a corn crop have to depend upon the rainfall.

Cross-examination by counsel for Colorado (297):

The general effect of the value of lands here as the years have proceeded has been that land is worth more now. Prices have gone up all over. There has been a general rise all over the country. There hasn't been much change in price for several years in Sedgwick County. The first bottom lands are more valuable.

Redirect examination:

The value of the land would be one-third more if we had the underflow back to what it was in 1878.

G. M. Shive, of Burrton. Direct examination (300):

The lowering of the underflow on the first bottom lands has had the effect to cut the corn off badly for want of moisture.

Cross-examination by counsel for Colorado (301):

I rotate the crops, but haven't used any fertilizer. Land is worth more now than in 1885. I do not desire to sell my land. I am perfectly satisfied with it. I think it is a pretty good investment.

Redirect examination (302):

When I stated that I was satisfied with my land, I would be better satisfied with it if the underflow was restored as I knew it first. It would be more valuable to me.

Silas Rutledge (302):

Have lived in Sedgwick County, Kansas, from 1871 to 1902, and owned lands within forty rods of the Arkansas River.

The falling of the underflow has decreased the productiveness of the soil. Don't get as heavy crops as formerly. They are not so certain. The fall of the underflow has affected the general productiveness of my land from ⅓ to ½ (302–303).

Cross-examination by counsel for Colorado (303):

Purchased my land for $22.25 an acre in 1870. Sold it in 1902 for $50 an acre.

John W. Shive, of Burrton, Harvey County, Kansas. Direct examination (310):

The river has filled in, in some places, and the banks have changed. Between Wichita and Hutchinson the bed of the river is at least one-third narrower than it was in 1871. Trees growing on the bars in the river. The bed of the river is not as deep as it used to be. There are islands and grass in what was the bed of the stream thirty years ago. The bed of the stream will not permit the same amount of water to pass down the channel (310). The lowering of the underflow has affected the crops in this valley. Of corn and such vegetation about one-third (311). Has not affected wheat and oats very much. The lowering of the amount of the underflow has lessened the productiveness of this valley so far as my observation and information extends at least one-third (312).

Cross-examination by counsel for Colorado (313):

Didn't fertilize land. Have diversified and rotated the crops. Have never had a failure of alfalfa on my land. My land is still productive in wheat. The channel is probably as deep in the bank as it was formerly. Think the bottom on which the river runs is about the same depth on the general surface as it used to be formerly (313). For the first fifteen years after I became acquainted with the river, since 1871, have always had what was called the June rise, and that would extend largely through the summer. Of late years we have had very little rise at all, but when the rise would come it was about the same time of the year when we would get the floods. As a rule the water comes a little earlier now (314). There has been no time prior to four years ago when land has been any higher than it has been for the last four years in my locality. In the main there has been a steady increase in farming lands in that section of the country. During the last six years the increase in the value of land has been about twenty-five per cent (315).

R. E. Lawrence, of Wichita, Kansas. Direct examination (321):

The river is just about half as wide at Wichita as it was in 1870. Between Wichita and Hutchinson I suppose it is about two-thirds as wide as it was then (321). There are more islands in the river than formerly, and trees have grown on the islands and along the banks of the river. The outlet for excessive waters in the river below the mouth of the Little Arkansas is not as good as it was in 1870. If the river had not been narrowed, I think the flood of 1904 at Wichita would have gone down a little more rapidly than it did (322). The lessening of the underflow has endangered the crops very much. The valley is as productive now as it was formerly when we get plenty of water (323).

Cross-examination by counsel for Colorado (324):

Noticed a decrease in the water in the river about 1890. They filled in about 200 feet at the Douglas Avenue Bridge at Wichita when they first built it in 1871 or '72, and thus narrowed the river about 100 feet. They took a span out of the bridge in 1884–5, and narrowed it up again about a hundred feet (324). They took out another span in 1887 and narrowed the river a hundred feet more. They took out another span about 1891–2 of a hundred feet, and narrowed the river to that extent. At the time of the last encroachment we thought the volume of the water in the river was less than it had been in earlier years. Now, a great many of the people want something done to get the channel of the river where it should be (325).

" * * * As soon as prairies fires were stopped trees began to grow in all the low places and in the sloughs and branches, and wherever there was a little moist ground the cottonwoods would start up, and that is in part the reason why the timber has grown along the edge of the Arkansas river. In the former times they didn't grow there, because the whole country was swept by fires" (330). My idea is that the yield of corn out of the valley in this county is increasing per acre but not in amount. I think this has been brought about by intensive cultivation. I think lands are rather advancing in value. I should say that the bottom farm lands, equally well located and with equal improvements, would sell for 25 per cent more than the uplands. On a tract of 125 acres near the river there has been about twenty-five acres of made land (331):

Redirect examination (332):

The land is not as valuable as it would be if the underflow was the same as during the first fifteen years that I knew the country. There are now better improvements upon the land. Markets are nearer. There are better shipping facilities. Increased population. Packing houses and manufactures. All these account for the increased value of land. From the standpoint of productiveness the land is not as valuable as it was fifteen years ago.

B. H. Campbell, of Wichita. Direct examination (335):

The banks of the river are closer. The bed is narrower than formerly. The islands in the river have increased, and trees and grass have grown thereon (335). The productiveness of the soil in the first and second bottoms has been much impaired by want of humidity from subirrigation. Lands are more valuable than in the early years, but they do not produce more (336).

Cross-examination by counsel for Colorado (338):

I am sorry to say that the cultivation of the land to corn in this vicinity, without rotation with other crops, is practiced too much here. To raise continuously one crop, unless like corn or alfalfa, which is a fertilizer itself, impairs the fertility of the land (338). In my judgment whenever corn or any other crop has grown for a number of years in succession it impairs the productiveness of the soil (339).

C. P. Fullington, of Wichita. Direct examination (340–341):

Thinks the lowering of the water level under the land in the valley has affected some crops adversely, such as corn; possibly wheat, Kaffir corn, etc. It may have affected fruit and other trees. Don't believe it would be disastrous to alfalfa.

Cross-examination by counsel for Colorado (344):

Some of the lands in the western part of the State have increased in value. Don't know a locality where lands have decreased in value. The net result is an increase.

Redirect examination (344):

If the water were within a foot of the surface would consider a fall of four feet beneficial. A greater depth would be detrimental. A fall of a couple of feet would be beneficial.

D. A. McCanless, of Wichita. Direct examination (344–346):

While this underflow was full up and the river was full of water there was a kind of subirrigation and the roots of corn would reach that. The corn would grow because the roots would reach the underflow. It is not so now.

Cross-examination by counsel for Colorado (347):

We call this underflow subirrigation. Never heard it called underflow until this suit came up. We use the term as an advertising medium. The Indians used to tell us that the river once covered all this country (347). From the reasons they gave I think the claims were well founded. When I first came to the country in 1869 there were no trees at all except a few isolated ones along the bank of the river, burned on one side. The Indians always burnt it off every year, and that prevented a growth of trees. There is a hundred times more timber in this vicinity up and down the river than when I first came here (348). Never heard the matter of the lowering of the water in the valley discussed until 1890 (350). It would be a mighty good country in which the crop would not decrease if the river had remained as it had been theretofore (351).

Hiram W. Lewis, of Wichita. Direct examination (352):

From 1876 to 1886 the river at Wichita was 1,100 or 1,200 feet wide.

Cross-examination by counsel for Colorado (353):

Have been engaged in loaning money on farm lands. There has been a gradual increase in the values of farm lands for the last thirty years. Lands are probably as high now as they ever have been.

A. B. Caldwell, of Hutchinson, Kansas. Direct examination (357):

Consider that the falling of the underflow has affected the certainty of the corn crop in this valley.

Cross-examination by counsel for Colorado (358):

Have noticed on lands where the corn crop had grown less in later years that alfalfa had been produced afterwards. Nearly double the amount of land in cultivation that there was fifteen years ago (358). From the standpoint of diversification of crops upon the land, it is just as valuable from a productive standpoint in the counties of Reno and Sedgwick as it was fifteen years ago. We do not have the hot winds we had years ago, and the rainfall is better distributed than formerly (359). Should say that the lands along the river have been as high in value for the last five years as they ever were for any five-year period since I have known the country. There is more plowed land than in 1855 and there is more timber (361).

Redirect examination (362):

The productiveness of the land in the valley in regard to corn has been affected.

R. A. Patton, of Arkansas City. Direct examination (365):

Don't think the river is much over one-third as wide now in the vicinity of Arkansas City as it was in 1882. Again noticed decrease in river about 1890.

Cross-examination by counsel for Colorado (366):

When I first came to this country, in 1882, we used to have a June rise in the river. We thought it was from the snow in Colorado. We don't have those rises like we used to have them. I think we have more rainfall now than we used to have during May and June, and it is more equally distributed throughout the season.

Johnson Keller, near Arkansas City. Direct examination (375):

On the bottom land we did not entirely depend upon the rainfall for a crop prior to 1890. Being close to the water, it kept crops alive and matured them, while back on the uplands they were burnt up. I raise nothing now but wheat, because it matures before our drouth commences. Had to make a change because it didn't pay to raise anything else. This change in productiveness on the bottom lands as to corn became noticeable between 1889 and 1891 (376). The channels of the river do not seem to have changed (377).

Cross-examination by counsel for Colorado (378):

There has got to be something left on the ground or it will deteriorate. In his country they take everything off the ground, as a rule, and feed it to the cattle or take it away.

John Myrtle, who has lived two and a half miles southwest of Arkansas City since 1883. Direct examination (381):

Decrease in the water in the river began to take place about 1888 or 1889.

Albert H. Denton, of Arkansas City. Direct examination (393):

In the seventies we thought we had some benefit from the underflow from the river for corn (393). Think bottom land is better yet, but haven't as good crops as in the early years (394).

Cross-examination by counsel for Colorado (394):

We are now raising more wheat than corn. On one field in our neighborhood corn has been growing for twenty-two years. My judgment is that it has deteriorated (394). Think the values of bottom lands along the Arkansas river in Cowley County much higher than they were fifteen or twenty years ago. There has been a steady and general increase in values, I think (395).

James Benedict, of Cowley County. Direct examination (396):

In 1877 and 1878 the average width of the river was three or four hundred yards. Diminution of the water in the river became noticeable in the latter part of the eighties.

Cross-examination by counsel for Colorado (400):

Farming lands in this county have advanced from $20 to $40 per acre during the last twenty years. There has been an increase in the last ten years. The bottom lands have also increased in value during these years as much as the uplands. There never was a time in my knowledge when the bottom lands were of greater value than at the present time.

Redirect examination (401):

Think the land has been less productive because of the diminution of the water in the river.

R. J. Stevenson, Cowley County. Direct examination (402):

Always thought the subirrigation on the bottom lands was a benefit to corn. Don't think the bottom lands in recent years yield as well as in early days. Think this is due to the dropping of the underflow.

Cross-examination by counsel for Colorado (403):

I never fertilized the land.

W. H. Speers, of Arkansas City. Direct examination (404):

For ten years after 1870 we used to get from 50 to 75 bushels of corn to the acre. During the last ten years we haven't gotten more than thirty bushels to the acre (404). Noticed the diminution in the river somewhere along about 1887 to 1890 (406).

Arthur H. Green, who resides 10 miles from Arkansas City on the Walnut. Direct examination (412):

My farm is on both sides of the Walnut. Have lived there since 1882. There has been no material change in the flow of the Walnut in the last twenty years. It rises in Butler County and is mainly fed by rains and springs.

R. E. Edwards, of Kinsley, Kans. Direct examination (425):

During the early years there was such a thing as a June rise. In that month it used to run bank full, generally. Believe the June rise came from melting snows in the mountains. During the last years the June rise has been very light. The bed of the river has narrowed one-third to one-half in Edwards County. The filling up of the banks of the river has not been artificial. It is a natural filling (425). The lowering of the underflow has diminished very largely the production upon the bottom lands. We had a better crop always when the river was running nearly bank full than when there was comparatively little water in the river. My alfalfa crops during the last few years have been slowly growing less, and I attribute it to the absence of the water in the river. Same decrease in the productiveness of alfalfa extends to other lands than those that I own (427).

Cross-examination by counsel for Colorado (428):

"Kinsley is located at about the 99th meridian. Possibly in this vicinity the increased rainfall has made the uplands more productive, and has offset or compensated any loss of water that existed twenty years ago, but we haven't enough withal. * * * If we still had the underflow and also the increased rains, I think our bottom lands would be still better than they are (428). * * * I had some money in a ditch here at Kinsley. It was for the irrigation of the soil. We proposed to take water from the Arkansas river by tapping the surface flow." The name of the ditch was the Crawford, and it was constructed in 1879. It was proposed to cover seven or eight thousand acres. No crops were ever raised from it, but the water was turned into it. The hot winds are not as severe as they were formerly (429). In the drainage area of the Arkansas river, in Edwards county, think there has been an increase of fifteen per cent in the plowed lands since 1885. Kinsley is about 160 miles from the Colorado line (431).

Floyd E. Wellman, of Kinsley, Kans. Direct examination (436):

The river has filled in naturally since 1885. Noticed this filling in more along about 1890. Since 1890 we have had very few June

rises (437). We don't have a good alfalfa crop when the water in the river at this point is low (438).

D. D. Baxter, Kinsley, Kansas, on direct examination by counsel for Kansas, testified as follows (440):

"In am the county clerk of Edwards county, and as such county clerk I have in my office the returns of the township assessors of this county, showing the acreage of the various crops of corn in this county from year to year. These returns show the total acreage of alfalfa in Edwards county for the year 1896 to be 4,976 acres. The latest record is for 1904, and this record shows the acreage of alfalfa for 1904 in Edwards county to be 1,777 acres. These records are compiled by the township assessors of Edwards county, and are returned to the secretary of the board of agriculture of the State of Kansas."

Cross-examination by counsel for Colorado:

"The only reason I can see for the falling off in the acreage of alfalfa between those two years is because it has not been a profitable crop between that time and this. (Objection.) The crop increased from 1896 to 1898. In 1898 it was more than six thousand acres, if I remember right, but from that time to this it has steadily decreased every year so far. I have the other books for the years intervening."

(By request of counsel for the State of Colorado, the witness produced the records of the township assessor for Edwards county from the time when the records were kept down to and including the year 1904, showing the acreage of alfalfa, wheat, corn and oats, which records show as follows:)

Year.	Alfalfa.	Wheat.	Corn.	Oats.
1886	(a)	7,338	21,254	5,89
1887	(a)	2,395	2,100	2,10
1888	(a)	32,091	24,762	5,97
1889	(a)	3,397	23,100	5,42
1890	(a)	9,291	20,582	6,08
1891	(a)	19,564	13,596	7,30
1892	451	29,923	12,899	8,11
1893	481	40,739	11,512	9,90
1894	1,155	45,415	14,841	6,26
1895	2,088	47,479	20,346	8,66
1896	4,976	40,024	20,789	10,42
1897	2,980	37,052	23,595	6,50
1898	6,923	47,916	18,747	5,42
1899	4,801	47,644	19,374	4,22
1900	1,961	43,525	25,032	5,14
1901	1,776	58,668	20,396	5,78
1902	1,559	69,182	21,945	4,73
1903	1,724	58,481	20,079	7,21
1904	1,777	130,165	23,396	5,81

(a) None reported.

William H. Vernon, of Larned, Pawnee County, Kansas. Direct examination (441):

The bed of the river in Pawnee County is very much narrower than it was in the early eighties. It has willows and brush growing in the river. It is filled up with sand until it is practically almost level with the country. During the early eighties the river was well stocked with fish. There are no fish in the river now.

Robert N. Wright, of Dodge City, Kansas. Direct examination (444):

Have known the river since 1859. Used to have a June rise at Dodge City. Generally at its heighth about the first of July (444).

The lowering of the underflow has had an effect on crops raised in the valley. It formerly acted as subirrigation (445).

Cross-examination by counsel for Colorado (446):

When I first came up the river, in 1859, I thought the country never would be inhabited. The country has improved very much more than I or the most sanguine expected (446). The June rises in the river continued longer in those early days than they do now (448). In the early days there was very little timber between Great Bend and the Colorado line, but a few scattering very large trees. There is a great deal more timber on the river now between those points. The reason for this is that formerly the fires and the buffalo destroyed the timber. The buffalo were here at that time by the million (453).

Redirect examination (455):

In the early years there was fish in the river. Haven't known of any being caught with hook and line for several years.

C. M. Beeson, of Dodge City, Kansas. Direct examination (457):

Have known the river since 1875. During the last fifteen years hay crop has fallen off one-third to one-half as compared to first fifteen years (458). Alfalfa crops close to the river are much better than they used to be, but back from the river they are not so good. The amount of land that is better for alfalfa now than formerly is about one-fifth or one-fourth. The yield per acre has fallen off about one-fourth, but the acreage has increased. During first fifteen or twenty years I was here the June rise would last up to about the first of August. During the last ten or twelve years there has been a scarcity of water (459). The floods recede much faster. This has had its effect in making everything short. There was a great amount of hay put up in the early days. This crop has fallen off to the extent of one-half, I think (460).

Recross examination by counsel for Colorado (462):

The wheat crops of late years has been on the increase in both acreage and yield up to this year. Unfavorable conditions this year are due largely to unfavorable conditions last winter (462). I have been growing alfalfa in this vicinity some ten years. Think the underflow had commenced to diminish before I began to plant alfalfa. Will not concede that alfalfa will do better where waters are receding from the ground. Alfalfa is one of the best crops that is raised here, and the acreage has increased each year for the last five or six years. This increase has not been at the expense of the other crops. I was here along in the late eighties. At that time the country around about Dodge City was regarded as unsuitable for farming, and a large percentage of the population went away (464). Notwithstanding the fact that the river has fallen off since that time it is better farming country than it was then, I think. There are more people here engaged in farming, and they are doing better. Land is worth more and is gradually and steadily increasing in price (465). There has been a great deal more of the outlying country along the drainage area of the river in this county broken up and put into crops than there was fifteen or twenty years ago. I think that has had a good deal of influence in preventing as much run-off into the river (466). There are many windmills operated in this county. Practically every farmer has a well with a windmill, and there are about three hundred of these wells in the county (467).

Redirect examination:

Don't think there is as much water now to supply these windmills as there was before the underflow was lowered. The productiveness of the bottom lands has decreased because of the lowering of the underflow. The value of the lands has been decreased for the same reason. If there has been a rise in the price of the bottom lands it is not because of the lowering of the underflow (467).

L. J. Pettijohn, receiver of the United States land office in Dodge City. Direct examination (469):

Produced maps from land office showing the meandering of the river and width of same in certain places in Ford county. The width of the river as shown by the survey in part of township 26, range 20, is 1,419 feet. Other widths were shown, varying from 1,500 feet to 1,600 feet, and the surveys were made in 1871 (471).

H. B. Bell, of Dodge City. Direct examination (473):

Lived in Dodge City for thirty years. The channel of the river is much narrower than it was.

Cross-examination (475):

In the real estate business. Don't think farm lands are quite as high on the average as they have been at some times in the past. They started to go up again two or three years ago and they have been going up gradually ever since, I guess. The country has been very successfully farmed of late years.

Redirect examination (475):

In my judgment the bottom lands along the river would be more valuable if the underflow was as high now as it was when I first knew the river. In my judgment the existence of the underflow adds to the productiveness and value of the bottom lands. Since I came here the population of the county has increased in the bottom lands and also in the uplands.

On page 474 on cross-examination this witness said that he had never noticed that the water had sunk to a greater depth below the surface than it was formerly; that he had made no investigations and had no accurate information on the subject.

S. Gallagher, jr., of Dodge City. Direct examination (475):

Have known the river since 1877. We generally get a small June rise here but nothing in comparison to what it formerly was. We are now depending on local rains. The June rises now don't last as long as they used to. Nor is there the same volume of water. The June rise raised the underflow above the normal condition and gave life and vigor to the hay lands along the bottom (476).

On cross-examination by counsel for Colorado (477):

The channel of the river changes with every freshet. Saw the river dry in 1878. The amount of land under cultivation and crops have been more than double along the Arkansas river in this country since 1877 (477). My opinion is that the underflow has a diurnal tide. Twice a day it has a perceptible rise and fall. Do not believe it is dependent upon any local rises (478).

H. D. Chambliss, of Ford County, Kansas. Direct examination (479):

In the early days had June rises in the river. Don't think they have any real June rises now.

Cross-examination by counsel for Colorado:

Thinks there is a great deal more country under cultivation i

Kansas along the Arkansas than when he first knew the river in 1872. Plowed land will absorb more water than land that has not been plowed (480).

George C. Laird, of Ford County, Kansas. Direct examination (484):

Has a place a little over a half a mile from the Arkansas River. Lived there six years. Yield of alfalfa has fallen off one half since he first came to this country, six years ago. Attributes this to the lowering of the water in the river.

George W. Reighard, of Dodge City, Kansas. Direct examination (486):

Lived in Dodge City since 1878. Used to have what is called the June rise. Always counted on high water in the summer. The June rise came when the snow melted in the mountains. During late years we got no water from the melting of the snow in the mountains. This changed condition began about twelve or fifteen years ago. We used to get six tons of alfalfa to the acre from about 1890 to 1892. It gradually fell off and now produces probably three and a half tons of alfalfa to the acre (487). Attribute this falling off to the lowering of the underflow (488).

Cross-examination by counsel for Colorado (488):

Also attribute the falling off some to the pasturing. We used to allow a large number of cattle to pasture on the alfalfa all winter. We don't pasture it as heavy now.

(*b*) *Defendant's Witnesses.*

Louis G. Carpenter. Direct examination (688–691):

"Referring to crop conditions and the production of lands along the Arkansas river in Kansas, I will state that we have at hand the complete agricultural reports of the State of Kansas, which we have examined. The Solomon river is one from which no water is taken for irrigation unless in an extremely small quantity, and I think there is none at all; and this is also true of the Smoky Hill river. These streams rise in Kansas and their course is almost entirely in that State. I have taken from the statistics of the State of Kansas, as prepared by their State board of agriculture and published in their annual or biennial reports, the production of the various staple crops (688), and made calculations for the purpose of comparing the increase or loss in production per acre in the counties in Kansas along the Arkansas, Smoky Hill, and Solomon rivers. These statistics are gathered by the secretary of the board of agriculture of the State and are made quite complete. I believe they are published under authority of law in the State of Kansas, and it is so stated in the volumes. I have compared the productions of corn and of wheat in the counties along the three river valleys mentioned and have especially compared the counties that were similarly situated with respect to longitude, so that they were under essentially the same conditions as to rainfall and most physical conditions, only that one set of counties was in the Arkansas valley, one set was directly north in the Solomon valley, and one set directly north in the Smoky Hill valley. I have produced three graphic maps of the figures taken from those reports. First, of the winter wheat. (Objection.) The figures shown on these various diagrams are accurately taken from

the Kansas reports to which I have referred, and the computations are correct. The three small prints or tables give in figures the results and actual figures from those reports, and at the bottom of each column is given the volume of the Kansas report and the page or pages from which they are taken. These have been gone over twice, so that I think it is a correct transcript of the figures given in the reports. These tables are arranged to show the yield for each year and each county, and taking the Arkansas river counties, starting from Hamilton county on the west, we have here the yield of winter wheat as given in that report for the first year when that figure is given, which in that particular case was 1888. So for Kearney, Finney, Gray and on down to Cowley county on the south border of the State. Nearly all of the reports from which these were taken were biennial reports. Starting from 1877 the State seems to have printed its reports biennially; before that annually. The same kind of a diagram is given for the Solomon River valley—that is, for the different counties that are in the Solomon River valley, including both forks. This table starts with Thomas county, Sheridan, Decatur, Norton, and other counties down to Ottawa; and similar figures are given on the next diagram of the counties in the valley of the Smoky Hill. Attached to these three diagrams is a graphic map reducing by that method of illustration the facts shown by the figures in the three diagrams just described. The diagram on the map attached shows two things—it first shows those tables in a graphic form by lines instead of figures, showing the ups and downs from year to year; and, secondly, it shows the location of these counties by a map on the side of the diagram. It shows the State of Kansas, and shows these various groups outlined with a little heavier borders so as to indicate what counties are referred to in speaking of groups 1, 2 and 3. The graphic map to which I have just referred and the three diagrams constitute different parts of a whole and should be kept together as one exhibit (689).

"To explain more fully this map and diagram, I will state that the groups of counties which are shown in each of these drainage basins as groups 1, 2 and 3 were so arranged as to bring together the substantial facts shown by the tables without too much confusion. The counties in the extreme western part of the State in each of the valleys—the Smoky Hill, the Solomon, and the Arkansas—were termed group 1. That set of counties which had an eastern border practically in the same north-and-south line—this took in the eastern border of Gray county and Finney county, in the Arkansas valley. In the Smoky Hill and Solomon valleys it took the counties directly north of this set of counties. Their eastern line was within six miles of being directly north. The second group of counties in the Arkansas valley took in Ford, Kiowa, Edwards and Pawnee counties. The second group in the Smoky Hill valley took in the ones directly north as near as could be—that is, Trego and Ellis counties; and on the Solomon river the four counties directly north. The third group was formed in the same way, taking Barton, Rice, Stafford, Reno, and Harvey counties, on the Arkansas river, and the counties similarly situated on the Solomon and Smoky Hill. The counties were then grouped and three sets of diagrams made, which are shown on the chart. The chart

simply represents in graphic form the figures of the table. At the top of the diagram are shown the years. At the left hand of the diagram is shown the number of bushels per acre, so that, for instance, where a yield of twenty bushels to the acre, say in 1891, is to be shown, the point will be taken at the intersection of the line for 1891 and the line representing twenty bushels to the acre. A line is drawn through the different points representing the yields of the different years, so that the fluctuation of the line up and down shows the fluctuation of the yield of winter wheat, which is represented in this set of diagrams. Hence the three upper lines in the exhibit show the corresponding facts for the three groups of counties called group No. 1 in each of the three valleys. The middle set of three lines shows the corresponding variation in crop yield for the second set of counties, or group No. 2, and the third set of three lines shows the corresponding variations of yield for group No. 3. Hence if the lines vary up and down nearly all alike it shows that the yield of crops in the three sets of counties, or the three river valleys, varies correspondingly; and it will be noticed in the diagram that there is a remarkable parallelism of the lines representing the yield of crops in the corresponding group of counties in the three valleys—that if one runs up so does the yield in the corresponding set of counties in the next valley. The lowest line represents the fourth set of counties in the Arkansas River valley. That is alone because of the fact that there is no corresponding group of counties in the other watersheds. As a whole, while there is a great variation in the yield, taking the same set of counties through a series of years (690), it is also evident that the same fluctuations of yield take place in the other watersheds as in the Arkansas valley; and, as said, the other streams have not been interfered with by taking water from them for irrigation. They are Kansas streams. These facts would seem to show that whatever causes the fluctuation in the yield of crops in the Arkansas valley has had the same effect on the yield in the Smoky Hill valley and in the Solomon valley."

(Objection.)

(Defendant Colorado's Exhibit 28 offered in evidence. Objection.)

"Three diagrams and a map, marked Defendant Colorado's Exhibit 29, are prepared from the same agricultural reports of the State of Kansas, in the same manner, for groups of counties in the valleys of the Arkansas, Smoky Hill, and Solomon rivers, and show the same general facts as to the corn crop in those valleys. The diagrams on the same group of counties show remarkable similarity. (Objection.) If one goes up, indicating a large crop, so does the corresponding line for the other river valley; and if the crop goes down in one valley it also goes down in the other valleys. They are so remarkably similar that it would make very little difference which one of the diagrams representing the yield was taken—that is, the diagram representing the yield in the Smoky Hill valley is almost identical with that in the Arkansas valley. It makes very little difference so far as the character is concerned. (Motion.) In the graphic map, Defendant Colorado's Exhibit 28, and also Exhibit 29, if the line goes up it indicates an increase in production; if it goes down it indicates a decrease. (Objection.) And as I was describing the diagram I spoke then of the lines going up or going

down. Those expressions would be synonymous with the increase or decrease of the yield per acre. (Motion.)" (691.)

Henry Block, of Syracuse, Hamilton county, Kansas. Direct examination (1454):

Came to Hamilton county February 2, 1886 (1454). From 1886 to 1889 the flow of the water in the river was pretty much at that time as it is now (1455).

Dan Larmor, of Garden City, Kansas. Direct examination (1462):

Have lived within two miles of Garden City since 1884. Have had occasion to notice the flow of the water in the river. It has been very good the last two or three years, but not as much as during the first three years I was here, and not quite so steady. I own bottom lands (1462). The crops have been about as good during the late years as during the early years. Last year they were better than usual. There were intermediate years when the bottom hay was very light (1463).

Cross-examination by counsel for Kansas:

The cause of the poor crops in those intermediate years was the shortage of the water in the river. The subirrigation was lower during those years because we did not have so much water in the river (1463).

Redirect examination (1464):

Have never had a failure of crops for want of moisture.

Berry W. Nolan, of Garden City, Kansas. Direct examination (1465):

First saw the river in 1880, at Granada, within the State of Colorado, near the State line. Very little water running in the river (1465). Believe there is more water in the river this year and last year than in the earlier years I was in this vicinity. Three years ago the river was perfectly dry (1467).

D. E. Hogbin, of Syracuse, Kansas. Direct examination (1469):

Lived in Syracuse since 1890. Came to that part of Kansas in 1883. The flow of the river at Syracuse has increased during the last three years, as compared with the years preceding, and the steadiness of the flow during the irrigating season has been more uniform (1469). The average flow of the Arkansas River near Syracuse during the last three years is about the same as from 1883 to 1887. Taking cycles of from three to five years from 1879 up to the present time, don't think there is very much difference in the flow of the river between now and then (1471).

Cross-examination by counsel for Kansas (1472, 1473):

The flow of the water in the river during the last three years has not been any more than formerly, but it has been more uniform during the irrigation season. Thinks the average width of the river in Hamilton county is about 800 feet.

B. F. Stocks, of Garden City, Kansas. Direct examination (1475):

Located in Garden City in 1885. Owned a farm in Finney county continuously to 1903 (1475). Doesn't think the taking of water from the river for irrigation in this county has affected the flow of the river below (1479).

Nathan F. Weeks, of Garden City, Kansas. Direct examination (1492):

Resided at Garden City since 1878. It seems to me that the flow of water during the first two years I was here was about the same as

the flow of the water in the river during the last two years. I don't see much difference. (The last two years refer to 1904, 1905.)

George Hill, of Kendall, Kansas. Direct examination (1494):

Kendall is forty miles west of Garden City (1494). Lived there since 1879. Raised crops since 1879. Crops been uniformly good. Never had a failure of crops by reason of water from underneath not being sufficient. Never noticed that my crops were any less on account of the rise and fall of the river. Never heard anyone complain that their crops had been injured or affected by the lowering of the water level underneath their land. Have sunk wells on the first bottom land. Three of them about a quarter of a mile from the river and one about a half a mile. The well a quarter of a mile from the river was dug in 1879 (1495). As far as I could see the difference in the level of the water from one part of the season to another throughout the year was about the same. Noticed from time to time the water level in a well and there was no change that I could notice (1496). Heard no complaint or suggestion that the water level in the wells along the river has been lower in any well. Never heard that they were raised or lowered by the rise and fall of the river. Never heard any complaint from anyone, neither east or west from where I lived, that the water level in the bottom lands was lower than formerly, or that crops had been affected by the falling of the water level underneath the bottom lands (1497).

Cross-examination by counsel for Kansas (1497):

The water level might have changed two or three feet and I not have noticed it on my alfalfa at all, as the roots go down to water. Think the normal flow of the river from 1890 to 1900 was less than the normal flow from 1880 to 1890. Think the dry periods are longer during the last ten years than during the first ten years I observed the river. The June rise does not last as long now as formerly, nor is the volume as great. When there is a rise now it comes and goes very suddenly (1498).

Redirect examination (1499):

Don't think that the level of the underground water could have gone down about three feet without my knowing something about it.

R. S. Crane, of Dodge City, Kans. Direct examination (1500):

Have lived in Ford County, Kansas, twenty years. Engaged in the real estate business. In the early years there were not the crops there are now. The land wasn't in cultivation then. Don't know of any grass lands along the river which have fallen off in productiveness during recent years. Haven't heard any complaint from farmers or others in this vicinity to the effect that the grass lands have been poor or worse in these later years than in the earlier ones. They grow a good deal more alfalfa than they did formerly (1500). Take it from 1890 to 1905, as compared with the last five or six years, think alfalfa land has increased fifty per cent, and from 1895 to 1900 it has increased along every year constantly. Haven't heard any complaints among the farmers to the effect that crops are not as good or have been reduced on account of the water level being lower, or anything of that kind. The lands around here raise as much and are as productive now as they were in the earlier years. I am acquainted with land values in this (Ford) county. The value of lands for the last seven years has been increasing; the uplands about 600 per cent. The bottom lands have increased about 50 per

cent during same time. Lands have steadily risen in value since 1898. I would say that the general average of value of bottom hay lands in this vicinity is about $35 an acre. In 1897 they were offered at about $15 or $18 an acre (1501).

Cross-examination by counsel for Kansas (1503):

Never heard of the underflow until it was talked about in connection with the Eureka irrigating canal, which runs about a mile and a half north of Dodge City (1503). The uplands have increased in value more rapidly than the bottom lands because they were so cheap—they didn't seem to have any value (1504).

Several other witnesses were examined by defendant at Dodge City along the same lines as Mr. Crane, among them men who owned and had cultivated lands along the river bottom in Ford County, Kansas, and their testimony in substance and effect is the same as that of Mr. Crane, viz., that the flow of the river in recent years compares favorably with that of former years; that better crops are raised now than formerly, that more land is cultivated; that the value of land has increased and is steadily increasing; that there has been no loss in the productiveness of the soil by reason of decreased flow in the river or the lowering of the level of the underground water. These witnesses were R. W. Evans (1505–1510); John D. Sidlow (1510–1516); Charles E. Argabright (1516–1524); William J. Spencer (1524–1532); H. Juneau (1533–1546).

The following witnesses were examined by defendants at Larned, Pawnee County, Kansas, the county seat of said county, viz: George K. Lee (1547–1550); T. G. Payne (1551–1555); Peter Schnack (1555–1557); E. E. Frizell (1557–1566); Emma Leasure (1566–1570); William H. Brinkman (1570–1574); and A. A. Thorp (1575–1582).

As fairly typical of the testimony so adduced at Larned that of E. E. Frizell is selected. On direct examination (1557) he says, in effect, after stating his age as forty-five and that he is mayor of Larned:

Own land west of here in the Pawnee Valley. Formerly owned a tract on the river of about a thousand acres (1557). Came into possession of it in 1893–94. Came to this country in 1876. Resided here ever since. Lived on a farm in Pawnee County near Garfield, on the Arkansas River, from 1876 to 1881. Lands have been more productive in the last six or eight years than they formerly were. In later years lands have been more productive acre for acre than in former years—that is, lands which border upon the Arkansas river in this county. There has been no change in the water level that I know of since 1877–78. Am fairly acquainted with the farmers in this county. Never heard any of them complain that their crops had been injured by the lowering of the underflow. Dug wells along the river in 1904 (1558), about a mile from the river. These wells didn't rise and fall noticeably so far as I could tell. Lands have increased in value very materially in the past few years. The real increase in value has occurred in the past seven or eight years, and during that time they have gradually increased.

Have had more rainfall in the past few years than formerly and it is more even and better distributed. Fires would formerly destroy the growth of small timber that would start up along the river (1559). We have had very few prairie fires of late years. Before

the bringing of this suit never heard any citizen of this county complain that by reason of irrigation in Colorado or any other reason the ground water had subsided and thereby made their lands less productive or less valuable. I bought land in this county ten years ago for $4.50 and $5.00 an acre that is now worth $30 an acre (1560).

Cross-examination by counsel for Kansas (1561):

The wells I put down in 1904 are about a mile back from the river, and the water level there doesn't change when the pumps are standing still. At that point the water level is not affected by high or low water in the river. There were no trees along the river near Larned when I first came here. There are several hundred acres now (1561). Timber began to grow most noticeably about twenty years ago, and has increased very rapidly since. The channel of the river has changed and islands have become attached to the mainland by accretion. That has been going on throughout the entire county. Perhaps a thousand acres have been added in this way in this county. The river bed is not as wide as when I came here, but the channel is as deep. The river is not in as good condition to carry the flood waters as in the earlier years. A large volume of water going down the river now would do more damage than twenty-five years ago. The river bed has grown up to willows and cottonwood and other trees. We have had more damage from overflows since 1895 than formerly. The narrowing of the bed of the river and the growth of willows and trees in it is increasing rather than diminishing (1562). During the summer season the bed of the river in the State of Kansas above Wichita when there is neither rainfall in the State nor melting snow in the State of Colorado becomes practically and oftentimes wholly dry. The obstructions in the river are increasing. The overflow has not been very destructive in this county. Think it would be an advantage to our country if the waters of the river could be largely used for irrigation in western Kansas. The flood waters would not tear out our bridges (1563).

Redirect examination (1563):

The lands bordering on the river are not barren, sandy soil, uncovered with vegetation (1563). It has been the practice up and down the river to fill up the channels of the river and cause the river to flow on the other side in order to swell the acreage. I have known of the channel being dammed to cause the water to flow on the other side, and I have known of trees being planted on the main or added land. It has been the endeavor of the people of this country to facilitate and help the growth of timber. When I came here prairie fires were a very common thing every year. The effect of the prairie fires was to destroy what was growing on the banks (1564).

Cross-examination by counsel for intervenor (1566):

I gained sixty acres of land on the south side on a single quarter by accretion and two hundred on the other side.

Redirect examination (1566):

There has been practically no damage by overflow from the river through this county since 1895. During the flood of that year we had a very heavy rain the first of June, and the Pawnee Creek was flowing quite full. The river overflowed the lands not to exceed a quarter of a mile.

Recross-examination by counsel for Kansas (1566):

We have narrowed the channel of the river to gain the land.

The following witnesses were introduced and examined by defendants at Great Bend, the county seat of Barton County, Kansas, viz: George N. Moses (1582–1586); William B. Norris (1586–1588); Frank Gibson (1588–1592); Robert A. Bidleman (1593–1595); L. D. Williams (1596–1598); John Rogers (1598–1600); E. E. Epperson (1600–1602); John F. Lewis (1603–1606); Edwin Tyler (1606–1610); and F. D. Wilson (1610–1617). The general purport of the testimony of each of the foregoing witnesses is that there is very little if any difference between the average flow of the river during the last ten years and previous to that time; that the average flood waters may have been lighter than before the country was broken up and put under cultivation; that the level of the underflow is about the same; that there has been no loss in the productiveness of the soil in the recent years as compared with the former years; that lands in the valley of the Arkansas River are much higher in price than formerly; that the stream has narrowed somewhat by reason of tree growth along the banks and on the islands; that islands have appeared in the river and others have disappeared, and that some of the islands are getting larger and some are getting smaller.

A. A. Swarens, examined at Hutchinson, Kansas. Direct examination (1617):

Reside at Reno, Kansas, two and a half miles from Hutchinson. Lived there since June, 1871. Engaged in farming there since that time. Own 240 acres up there. Own land about a mile and a half from the Arkansas River. Cow Creek runs through my land. Have seen very little difference in the flow of the Arkansas River in late years as compared with earlier years. Have heard of the underflow. The highest place to water on our place is ten feet. Have had open wells there. Sank one in the fall of 1871. Have an open well now on the same place on ground of the same elevation. The level of the ground water at the present time, compared with the level of the ground water in the earlier times, is just the same. The crops in the vicinity of Hutchinson in the valley of the Arkansas River for the last six or eight years are better than during the earlier years. The price of land is higher now than ever before, except during the wild-cat boom, about the year 1888 (1617). Prior to the beginning of this lawsuit never heard any farmers complain that their lands had been made less valuable or less productive by the lowering of the level of the underground waters. During the last seven or eight years the climate has been better than formerly (1618).

Cross-examination by counsel for Kansas (1618):

Cow Creek never goes dry. High water in the Arkansas River has no influence upon my land that I know of. I am neither injured nor benefited by it.

Other witnesses were introduced by defendants at Hutchinson, Kansas, and the testimony of each, in substance and effect, is the same as that of the witness Swarens.

The names of these witnesses and the pages of the record where the testimony of each may be found are as follows: Dan Welchons (1621–1626); L. P. Hadley (1626–1630); George Foster (1630–1635); W. B. Jewell (1635–1640); and A. N. Culberson (1640–1642).

D. M. Sprankle, examined at Wichita, Kansas. Direct examination (1642):

Live four miles northwest of Wichita, Sedgwick County, Kansas. Have been engaged in farming there since 1876. Have a farm 160 acres about a mile and a half from the river on the first bottom (1642). From my observation have not noticed any material change in the flow of the river where I have seen it in this county during the last five years as compared with the flow for the first five I knew it. Nor has there been any change in the level of the ground waters. Aside from the natural deterioration which comes from the constant farming of lands, as to productiveness of my lands now and for the last five or ten years compared with their productiveness in earlier years, I would say some crops do not grow as well, principally the wheat crop, but I can't say in regard to corn. I think the land produced better crops of wheat when it was new than it does now. I believe that is usually the history of the wheat industry. Never heard the farmers in Sedgwick County complain that their lands were less productive or less valuable by reason of the lowering of the general water level of the country. Have heard them complain that they believed that if Colorado didn't take the water from the river we would have better seasons and more rainfall (1643). The price of lands in the river bottom are higher now than I have ever known them (1644).

Cross-examination by counsel for Kansas (1644):

Prior to the bringing of this suit never heard of any meetings being held by any of the farmers of Sedgwick County in the city of Wichita. Don't know of any association that was formed to advocate the bringing of this suit. We depend upon good cultivation for the production of our crops.

W. F. Stevens, of Wichita, Kansas. Direct examination (1646):

Am a retired farmer. Came to Sedgwick County in 1870. Located 16½ miles northwest from Wichita. Homesteaded 175 acres. Lived there until 1901. The land was located on the river. It was bottom land. My house was a half a mile from the river. Lived there thirty years. There were high water and low water periods during the early years and ever since. The river gets higher now than it used to. At least it overflows more than it used to (1646). In regard to the flow of the river, so far as my observation goes, it is practically the same, taking a cycle of ten years, from one time to another from the early days to the present. So far as my observation goes I have not noticed any difference in respect to the level of the underflow. Never heard of any of the farmers in this vicinity complain prior to this suit that the flow of the water underneath had fallen so as to injure their crops or lands. Never heard them complain that the lands had been injured in value by reason of the lowering of the underflow. We raised poor crops in the early days and we have raised better crops since. I attribute the loss of crops in those early days to the dry weather, and I attribute the loss of crops now to the same cause. Lands are higher in price than they were in the earlier days, and are getting higher all the time (1647).

Cross-examination by counsel for Kansas (1648):

I would rather risk the moisture from above than below. I have seen vegetation burnt up close to the river when it (the river)

was up. If there is not sufficient moisture from rainfall it don't raise a crop. When there was no rainfall the underflow probably influenced the productiveness of my land. There would be more moisture. We didn't have the higher underflow in a dry year. We have had periods of high water and of low water, and those periods were sometimes longer and sometimes not so long. We have had high water as late as August and during the balance of the year we would be liable to have low water. I believe that the periods of low water in the river were as long each year in the early years as they were from 1890 to 1901. The water overflows more by my place than it used to. It gets higher in the river than formerly. The river is not so wide at my place as it used to be (1648). The islands are growing over with trees and brush, and the chances are they are getting larger. Don't know as there are more of them (1649). The underflow rises and falls practically in harmony with the rise and fall of the river. This entends back under my land, at least (1650).

Other witnesses introduced by defendants at Wichita gave testimony to the same effect as the two preceding witnesses, among them W. G. Malone (1656–1660); J. R. Brown (1660–1665); Henry Loshbough (1666–1673); S. M. Tucker (1674–1682); Charles Schaefer (1682–1690); F. M. Dofflemyre (1690–1699); Joshua Rush (1699–1703); J. M. Hall (1703–1707); John Williams (1707–1711); J. R. Sites (1711–1716); Simon H. Loughlin (1717–1722); Jacob Lumbert (1722–1726); S. M. Belden (1726–1733); J. R. Sites (recalled, 1733–1744); Oscar L. Winters (1734–1740); J. W. Sites (1741–1744); J. T. Sites (1745–1749); L. B. Dotson (1749–1756).

The following-named witnesses were introduced by defendants and placed upon the stand at Winfield, Cowley County, Kansas: A. J. Shore (1756–1762); W. G. Carson (1762–1766); S. D. Lemasters (1766–1771); Ernest C. Morrill (1771–1777); E. W. Phillips (1777–1781); Moses Nixon (1781–1783); G. R. Hamm (1784–1785); Henry Hahn (1785–1788); John Thompson (1788–1789); J. M. Buffington (1789–1795); L. H. Hill (1795–1797); Joseph Hahn (1797–1799); A. D. Pennington (1800–1803); T. C. Price (1803–1805). The evidence of each of the foregoing witnesses was to the effect that he had lived in the valley of the Arkansas River near Winfield for a number of years and had cultivated bottom land; had observed the flow of the river; that the average flow thereof for the dry season had not appreciably decreased during the years since 1885 as compared with the flow of the river prior to that time; that there had been no falling off in the productiveness of the soil; that the price of land in the valley had risen; that no complaints had ever been made by farmers that their lands had been made less productive or made less valuable by reason of any lowering of the level of the underground water in said valley; that there were better crops than formerly and that land was more valuable than ever before. Most of the witnesses conceded that there was an underflow in the valley of the river; that it extended in varying distances on each side of the river; and some of the witnesses admitted that the rise and fall in the river had some effect upon the rise and fall of the underflow in the vicinity of the river. A number of the witnesses last above named testified in effect that

the level of the underflow had not gone down in recent years. Some of the above witnesses also testified that they hadn't noticed any difference in the width of the river as compared with former years, nor had they noticed that there had been an increase of islands in the river bed.

(f) TESTIMONY OF COMPLAINANT'S WITNESSES IN REBUTTAL IN RESPECT TO THE UNDERFLOW GENERALLY; DECREASE IN VOLUME OF WATER IN THE RIVER; GROWTH OF TREES; FORMING OF ISLANDS; NARROWING OF THE BED; AND DECREASE IN PRODUCTIVENESS OF ARKANSAS RIVER VALLEY LANDS.

At the conclusion of the taking of testimony by defendants, complainant introduced and examined a large number of witnesses in respect to the points enumerated above (1858–2285), all of which was objected to by the defendants (1869), and which they moved to strike out (2285–2286).

At Garden City.

A. H. Burtis. Direct examination (1858):

Came to Garden City on March 17, 1881. I have heard of the underflow in this section. The amount of water in the river determines its level. The underflow extends back to the uplands and farther. During the last ten years in the seasons when naturally water comes from the mountains there has been practically no flow in the river here. The river for 200 miles east of the Colorado line do not think is as wide as it used to be (1859). The channel has filled up with sand bars and narrowed a great deal during the last ten or fifteen years (1860).

Cross-examination by counsel for Colorado (1860):

The underground water rises proportionately with the water in the river. My judgment in this matter is based upon the fact that my cellar is dry when the river is comparatively low and damp when the river is high (1861).

Cross-examination by counsel for intervenor (1861):

"No doubt a small quantity of the underflow comes from the rainfall. * * * A large part of it comes from the river. * * * It comes from both sources no doubt * * *."

E. P. Barber. Direct examination (1872):

Have lived at Syracuse since 1873. (Syracuse is on the river west of Garden City.) Own land about a quarter of a mile from the river and right on its banks. I know something about the underflow (1873). Think it goes back to the natural bluff through Hamilton county. These bluffs would average about a mile and a half back from the river. My statements in regard to the underflow are based upon observations in the hay bottoms. We don't get nearly the amount of hay that we used to, because there is no subirrigation now to make it and there used to be ponds in the bottom. Now they are all dry. First observed the decrease in the pools or ponds about four years ago. In a well at my house three-quarters of a mile from the river it lowers from two to three feet when the river goes down. When the river rises it is well up again. The rains on the uplands don't seem to have any effect on the well. The average flow in the river has been decreasing in the last ten years. This has affected our bottom lands very much. Has nearly ruined our natural meadow (1874). I hear

complaints of my neighbors up and down the river that they are affected in the same way (1873, 1874).

Albert Pratt. Direct examination (1880):

Have lived at Syracuse since 1885. Own bottom lands in Hamilton County. My house is half or three-quarters of a mile from the river on the north side on the first bottom lands. The level of the water beneath my land depends upon the amount of water in the river. When the river is high, the water is nearer the surface than when the river has been low for a time (1880). The amount of water in the river influences the underflow as far as the bluffs. These bluffs bear from a quarter of a mile to two miles from the river west of Syracuse. The hay crop for ten years prior to 1904 is not nearly as good as for the first ten years after I came here. Think this change is attributable to the decrease of the amount of the water in the river. As to the average flow of the river outside of flood seasons for the ten years prior to 1904 as compared with the flow of the river for the first ten years I was there, I will say there has not been nearly so much water in the river in the last ten years except the last year (1881).

Cross-examination by counsel for Colorado (1883):

"I located in Hamilton county in 1885. * * * In 1885 and 1886 we had a pretty abundant flow of water in the river. * * * According to my recollection now, there was as much water in the river during those two years as during any years since that time."

Earlie Overton. Direct examination (1886):

Have lived in Hamilton County, Kansas, since 1879. Until about sixteen years ago lived on the river bottom south of Syracuse. The bottom lands in Hamilton County are about a mile and a half to a mile and three-quarters wide. Know what is understood by the underflow. It extends back from the river to the bluffs. The underflow to the bluffs responds in rise and fall to the rise and fall of the water in the river (1886). The hay crop during later years has been a great deal lighter than formerly. There is not nearly as much water in the river as formerly (1887).

At Dodge City.

L. J. Pettijohn. Direct examination (1902):

Receiver of the U. S. land office at Dodge City, Kansas. As shown by the records, the width of the Arkansas River in feet at Dodge City is 1,528; at Syracuse, 1,160; at Garden City, 1,181; at Kinsley, two miles south of the town, 1,904; at Great Bend, 1,584; at Larned, 1,486.

Cross-examination by counsel for Colorado:

Don't know when these measurements were taken.

Cross-examination by counsel for intervenor (1903):

It is supposed that the measurements were taken at the time of the extension of the public survey over the public domain out here. Do not know whether the measurements are correct. The width of the river testified to by me is the width between meandered lines on each side, and the width between those lines is not necessarily the width of the water itself.

John Riney. Direct examination (1903):

Live in Ford county, Kansas, a mile west of Dodge City, on the north side of the river. Have lived there since 1883. Own bottom

lands there (1903). Have a well there—one at the house and one at the barn. The water rises and falls in the well with the rise and fall in the river. The wells are a half a mile from the river. The underflow goes back practically to the uplands. The average flow in the river has not been as great in the last ten years as in the previous ten. This decrease in the volume of the river has had the effect of decreasing the productiveness of grass on the bottom lands, for the reason that the grass did not get subirrigation (1904). The river don't seem to be as wide as it was. There seem to be more islands in the river. Trees have grown up on some of the islands (1905).

Cross-examination by counsel for Colorado (1908):

Think my land has increased in value during the last three or four years. They are more valuable now than they were in the past.

Redirect examination (1909):

Quit raising corn after the river went dry and because of that fact.

Recross-examination by counsel for Colorado:

We are outside of what is known as the corn belt.

A number of other witnesses were examined by complainant at Dodge City, but in respect to the question of underflow, etc., their testimony did not differ materially from that of the foregoing witness. The names of these witnesses and the pages in the printed record where the testimony appears are as follows: J. H. Miller (1910–1914); Charles Herzer (1914–1919); O. H. Simpson (1919–1925); Charles H. Northrop (1925–1940); S. H. Thomas (1940–1949); Joseph Timmons (1949–1956); P. H. Young (1957–1968); James M. Imel (1968–1979).

At Larned, Kansas, counsel for complainant introduced and examined a number of witnesses upon questions involved in the case, among them that of the underflow, etc., viz., W. H. Johnson (1980–1983); S. S. Dickinson (1983–2011); Clyde B. Johnson (2012–2014); J. J. Nesbit (2014–2015); William A. Heller (2015–2018); and J. P. Worrell (2018–2025). The testimony of each of these witnesses, in effect, is that he owns land along the river near Larned, Kansas; has been familiar with the river prior and subsequent to the year 1885; that there is not as much water in the river on the average during the dry seasons of the year in recent years as there was prior to 1885; that the bed of the river has narrowed; that islands have grown and increased and that they have observed an underflow and that the level of the underflow is affected by the volume of the water in the river. None of the above witnesses, however, testified that the lands in the valley of the river had decreased in productiveness by reason of the decrease of the volume of the water in the river.

At Great Bend.

William B. Cornell. Direct examination (2026):

Have lived in Barton County, Kansas, since July, 1880. Owned a farm bordering on the river. Crossed the river nearly every day for a number of years. Do not think there has been as much water in the river from 1892 to 1903 as previous to that time (2026). The flow of the river used to require a wider channel, and outside of the floods we have now the water ordinarily does not require near so wide a bed. Noticed this change taking place about 1893. What trees we have are volunteer trees and they are now ten or twelve feet high. Formerly there were no trees along the river. We have lots

of islands here now where there didn't use to be any (2027). We used to count on the June fall from the mountains bringing the water down, but in the last two years that hasn't cut any figure with us. Right opposite Great Bend the flow of the water in the summer time is not a third of what it used to be quite a number of years ago. In those early years the underflow made its appearance in the shape of springs that came out of the pastures. At one time I had a spring 200 rods from the river. It does not exist now (2028).

Cross-examination by counsel for Colorado (2031):

Can't say that I have been either injured or benefited by the decrease in the volume of the water in the river.

Cross-examination by counsel for intervenor:

My land is worth a good deal more to-day than it was twenty-two years ago. I haven't been injured by reason of the flow of the river becoming less (2032).

C. Q. Newcomb. Direct examination (2032):

Lived in Barton County, Kansas, twenty-six or twenty-seven years. Farmer, surveyor, and civil engineer. The flow of the river with the exception of floods for the last ten or twelve years is considerably less than previous to that time. There are more sand bars and small islands in the river than in the earlier years. They have been increasing for ten or twelve years, more or less. The banks are closer together than they used to be (2032). Quite a number of trees have sprung up on the islands and sand bars. The underflow extends back from the river a half mile or more. It has sunk over two feet (2033). Think the lowering of the water in the river has been the cause of the sinking of the underflow (2034).

Other witnesses examined at Great Bend were G. L. Chapman (2038–2045); J. B. Miller (2045–2047); John H. Rupert (2048–2050); T. B. Unruh (2050–2054), and J. F. Lewis (2054–2056). The testimony of these witnesses, however, is substantially the same as that of the other witnesses examined by complainant at Great Bend, in rebuttal. None of the witnesses examined at Great Bend, in rebuttal, made any statement tending to show that the decrease in the volume of the water in the river had any appreciable effect upon the productiveness of the lands in the river bottom.

At Sterling.

J. B. Keeley. Direct examination (2057):

Have lived in Rive County, Kansas, two and a half miles southwest of Sterling, since 1877, with the exception of two years or thereabouts. Own 240 acres there on the north side of the river. It is practically all bottom land. From what I have observed in the last nine or ten years, would say that the flow in the river is fifty per cent less than it was for five years previous to 1890. When I first came here there were no trees in or on the banks of the river. The river was half a mile wide in places then. It is now filled with cottonwoods and islands (2057), and the main channel is not half as wide as it was. The cottonwoods have been growing rapidly on the islands for the last five or six years. Some of them have been growing for ten or twelve years. Formerly we had a June rise, supposed to come from the snow in the mountains. The river has not the same capacity for carrying flood waters that it had. The same volume of water would overflow much more land now than in the early days. I know

what is understood as the underflow. It is about six feet to water on my land. Think the underflow has gone down during the last ten years. It is lower now than formerly. The underflow extends back to my place, which is half a mile from the river (2058). I am positive of this fact from the digging of wells. The water would rise and fall in the wells with the rise and fall of the river, regardless of local rains. When I first came to Kansas, I raised corn only. Was very successful with it until the last eight or ten years, when corn ceased to be as productive, and I substituted wheat for corn. Corn is less productive now than in the early years because of the water or the subirrigation, as we call it (2059).

Cross-examination by counsel for Colorado (2065):

Lands are worth more in this country now than they were in the earlier years.

The following witnesses were also introduced and examined by complainant at Sterling, Kans., in rebuttal, but the testimony of each is the same, in effect, as the preceding witnesses examined at Sterling in respect to the volume of water in the river, underflow, narrowing of the channel, growth of trees, etc., viz: J. H. Smith (2066–2075); H. Swartz (2075–2080); and J. M. McGee (2081–2082).

At Hutchinson.

Samuel Hirst. Direct examination (2083):

Lived on a farm eight miles south of the city of Hutchinson from 1873 to 1881, seven and a half miles from the Arkansas River. The land was rather level. It was thirty-four feet to water. Had one open well. Drew water out by a windlass. We considered that the level of the water in the well was determined by the height of the water in the river. When the river was low the water was low in that well.

Cross-examination by counsel for Colorado (2085):

I do not know as a matter of fact that the surface of the water in the ground at the point where our farm was located is approximately fifteen or twenty feet higher than the level of the water in the river. Never ran any level over it. It was upland where the well was. I was born in 1864. I was seventeen when I first left home in 1881.

Frank Vincent. Direct examination (2085):

Have lived in Reno county since 1874. Was State Senator for four years. Elected in 1900. I introduced the joint resolution authorizing this suit (2085). I think there is much less volume of water flows down the Arkansas River than in the earlier years. The river is one-third narrower than it was in early days. The river has lately filled up with islands, and timber and brush have grown there. I have noticed this changed condition for twenty miles up and down the river. The islands have formed there since 1890. The channel of the river has not half the carrying capacity that it had twenty-five years ago. If the same volume of water should come down now that in the early days filled the river bank full, the water in the river would seek its level by percolating or subirrigating the bottom lands (2068). The underground waters rise and fall with the rise and fall of the river. This effect is produced five miles back from the river (2087).

Cross-examination by counsel for Colorado (2091):

All our lands here are increasing in value as compared with any former period. The country is quite prosperous here. There has been an increase all the while in cultivated uplands in Reno County and in bringing lands into cultivation. My judgment is that the bottom lands are more valuable than the uplands situated the same distance from the town or from the markets and with equal improvements.

Sheridan Ploughe, of Hutchinson, Kansas, on direct examination, testified to the same effect as the preceding witnesses as regards the condition of the river now as compared with former years, the underflow, etc., adding, however, that the lowering of the underflow had affected fruit trees owned by him in Reno County (2097).

Counsel for Colorado refused to cross-examine witness Ploughe in regard to the underflow, etc., for the reason that the direct testimony was not considered to be proper rebuttal.

Henry Hartford. Direct examination (2099):

Have lived in Reno County since 1872. Own 1,640 acres in said county in the valley of the Little Arkansas River, and it runs through my farm. My farm is about ten or eleven miles from the Arkansas River. Never saw the Little Arkansas dry. The Arkansas River drains into the Little Arkansas River. At Medora the Little Arkansas River is forty-five feet lower than the Arkansas River is at Hutchinson, according to Rock Island survey. The amount of the water in the Little Arkansas corresponds to some extent to the water in the big Arkansas. There are springs on the Little Arkansas, altogether on the south side (2099). The water from the little river was fed by these springs, which are on the west side of the Little Arkansas River. Lots of these springs have dropped off. We attribute this to there not being so much water in the big Arkansas River (2100).

Counsel for Colorado declined to cross-examine the witness for the reason that his testimony was not proper rebuttal.

L. A. Bigger. Direct examination (2100):

My business is bonds and loans. Formerly handled lands. Have lived in Hutchinson since 1873 (2100). Up to 1885 the river at Hutchinson would rise in May regularly and would continue to flow full to half full banks until about the middle of June or the first of July. During the balance of the year it would be very low, but always flowing some water, with one or two exceptions. One or two summers it went dry. There are more sand bars in the river now than formerly. The river has been narrowed about 500 feet. The bed of the river has been raised by the filling in of sand and the growing of islands. There has been a marked growth of trees on the islands during the last ten or fifteen years. The carrying capacity of the river is about two-thirds of what it was formerly (2101). The average flow of the river during the last ten or fifteen years is not as great as the first ten or fifteen years I was here. Know what is understood by the underflow. In 1893 I was obliged to put my wells deeper on the land I then owned, and some of the land I then owned was twenty miles from the river. Believed that the water in the river affected the water in the wells. Water was always more plentiful in the wells I speak of when the river was high than when the

river was low. After I sank my wells have had no difficulty in getting water. The water in the river affects the wells in the vicinity of Hutchinson (2102).

Cross-examination by counsel for Colorado (2104):

Have no idea how fast the underflow travels through the soil. The reason I think this underflow extends back as far as 25 miles south is because after I had had wells there for a time they went practically dry, and I had to sink deeper (2104). I had the finest water in town from a driven well. When they built the salt works on the other side of the river the water in my well became salty and unfit to drink. The salt well is about a half a mile from my well up the river (2105). It took about six or seven months to go from the salt well to my well. This salt well I spoke of was on the opposite side of the river from the well of mine which it spoiled. As to the direction the flow from the salt well would be to get to my well, the river runs southeast, and this would be almost due east. The general drop of the country here is from west to east (2106). The underflow or subirrigation is what we advertised here to get settlers. Practically all the land in this county is under cultivation. It seems to me that the uplands rely upon the underflow. Between here and the Colorado line the crops near the river are better than on the uplands. As you go away from the river the crops get more uncertain (2107). Think the underground water near Hutchinson has fallen thirty inches in thirty years (2108). I do not mean to say that this thing they call an underflow is an underground stream running in any well-defined channel like a stream on the surface. Sometimes I think there are little distinct streams, little crevices here and there, from the fact of the water being so much colder in those wells than it is, say, right here in Hutchinson. In a general way I should say that this whole body of underground water was percolating through the soil. Lands in Reno County to-day are worth about what they were in 1887. That was the high time of lands. In loaning money upon lands now do not think we take into consideration the underflow. We were much alarmed for a number of years, but we have had good crops in the last six or seven years on an average. Our crops have been very satisfactory. Do not remember a time when we had better crops than we have had during the last six or seven years (2109).

Redirect-examination (2110):

I can hardly say that the crops have been diminished greatly by the lowering of the underflow.

In addition to the above the following witnesses were examined at Hutchinson, and their testimony was along the same lines as the preceding witnesses examined at that place, viz: Joseph S. George (2113–2115); Charles Collins (2115–2119); and George W. Watson (2119–2125).

At Wichita:

J. R. Mead, of Wichita, Kansas. Direct-examination (2127):

Have been doing business on the Arkansas River since 1863. Have lived in Wichita since 1868. Preempted 160 acres of land that year in the heart of the city of Wichita. For more than twenty-five years have been a member of the Kansas Academy of Science, and have been its president. Twelve years ago I wrote an article for this society entitled "A Dying River." It was published in the proceed-

ings of the society. It had reference to the Arkansas River. In that article I described the condition of the river at that time and as it had been since my earliest acquaintance with it, and its probable future (2127). First struck the Arkansas River in June, 1863, six miles north of Wichita. The river varied in width from 800 feet to 1,600 feet. Where the river was wide it varied in depth clear across from eight inches in the shallowest places to two feet in the deepest places (2128). In the summer of 1863 the river continued to flow quite a continuous stream until some time late in the fall or the beginning of winter, when it went entirely dry. In January of 1864 there came without any premonition a flood filling the river from bank to bank, from a foot to two feet deep. The river continued to flow then for the remainder of the winter, and in the spring the usual spring rises came. It frequently occurred that the river was impassable in the early spring and summer months (2129). Prior to 1868 had seen the river dry above the mouth of the Little River twice. In the summer season during those early years there was not a great deal of variation in the habit of the river (2130). After the May and June floods the water in the river gradually subsided until it came to a uniform flow of clear, pure water, which usually continued to the late fall, and in a majority of instances all winter. The river at its normal condition in those days was about knee deep. In width, two or three miles below Wichita, it varied from 800 to 1,600 feet. Between Wichita and Hutchinson there were very few islands in the early days. There was occasionally a large permanent island like the one at the mouth of the Little Arkansas, and another at the mouth of Chisholm Creek, and some others up the river which had just simply a small narrow channel on one side, but which were almost attached to one shore or the other, and a few of what we call "tow-heads," little patches, which would disappear in a short time. The island at the mouth of the Little River was first known as "Lane's Island," because he preempted it. The Wichita waterworks are located on that island. When a survey was made in 1867 there were two little tow-head islands in the river at this place, one where the Douglas Avenue Bridge crosses and another about a hundred yards below, near the east bank, which is now built over with business blocks (2131). The big Arkansas River at that time as far up as the vicinity of Mount Hope, was usually but not always lined on both sides with a heavy fringe of large cottonwood timber, with occasional bends in the river which would be grown up solid with timber. The Little River was similar. Lane's Island was covered with large cottonwood trees in 1867, and the island at the mouth of the Chisholm Creek was covered with brush and timber, but not so large and uniform as the timber on Lane's Island (2132). The Arkansas River has been exceedingly erratic in its character since 1880. From 1880 there was a great decline in the volume of the river, and in the last several years there apparently has been during the summer an unusual increase in the volume of the river. Commencing about 1880 the river ceased to flow with its usual volume of water. What were formerly sand bars commenced growing over with cottonwood sprouts, and would make a considerable growth the first season, perhaps four feet high (2133). In the course of a few years those sand bars would gradually develop into a timbered island. In 1872 I owned a tract of land of 350 acres

fronting on the river at Hydraulic avenue, about four miles south of Douglas avenue, Wichita. At that time the river was about 1,600 feet wide. At the present time the current of the river there is not over 400 feet wide. The balance is timber, cottonwoods and willows. The river has narrowed up almost universally. The carrying capacity of the river at Hydraulic avenue for the last three or five years in comparison with the earlier years has been reduced about three-fourths, and at Ackerman's Island, here in the city of Wichita, the capacity has probably been reduced the same (2134). The average flow of the river, exclusive of floods, for the ten years last passed, compared with the average flow, exclusive of floods in the earlier years, has decreased one-half. I have the same general knowledge of the underflow in this country that the people generally have. The underflow runs in a southeasterly direction, or east of south. Where the city of Wichita is built the underflow extends to the high land, four miles, perhaps, or more (2135). In holes and cellars that I dug I have noticed that the water rises and falls in them with the rise and fall of the water in the river (2136). In my opinion the level of the water underneath is usually lower than it was in the early days (2137). I wrote the article entitled "A Dying River" because, first, it is a scientific fact of general interest. Next, it was a very marked or unusual phenomenon, and third, I had for many years anticipated very disastrous results in this valley in which I was largely interested. The narrowing of the river south of here caused the river to overflow its banks and did me a personal damage of probably five thousand dollars, and a number of my neighbors were injured more or less. This article was written in 1893. The channel of the river is getting narrower constantly (2138).

Before cross-examining this witness (2140) counsel for defendants moved to strike out examination in chief as not proper rebuttal, and announced that he would limit his inquiries to matters concerning certain dates, etc.

Cross-examination by counsel for Colorado (2140):

There is much more improved land along the bank of the river now than there was in the early seventies. The river overflowed its banks in 1867 (2140), but not to the extent that it has since. The next flood was in 1877. There was considerable territory overrun with water that ran through the streets of Wichita. There was a low place along where Topeka avenue is now located and there, I think, the water was four feet deep. In 1904 the flood reached a depth of 16 inches in the streets of Wichita. The 1904 flood originated in Kansas. In the early years the river was clear at ordinary stages; of late years it has been muddy. This changed condition I attribute to settlement along the river and its tributary streams, by which quantities of water, mud, and filth get into the river. In times of high water the river was just as muddy in earlier years as it is now (2141). Before the ground was broken up there was a very much larger percentage of the water running off the surface than there is at the present time or since the ground has been broken up, because it soaks into the ground and there are obstructions to its free flow. The water that now falls on the ground soaks into the soil. It was noticeable that there was a difference in the river before 1880, but not a very noticeable or pronounced difference. By the year 1880

it was sufficient so that it was observed and spoken of frequently and generally among the people that were here in the early days (2142). To the best of my knowledge, a large part of the State of Kansas lying south and west of the Arkansas River at some depth is underlaid by a sheet of gravel and sand containing water. That water is derived from every source—from all of the rains and streams running across the surface. They all contribute more or less. Perhaps they derive some of their waters from the mountains of Colorado. In the immediate valley of the Arkansas River I think the sheet water is considerably influenced by the water in the river. When the river is up to a good stage of water it flows back through this sand for long distances, and when the river falls it falls into the river, and the water in the underflow at different seasons of the year may vary in heighth by the amount of precipitation which may be over the plains and which sinks down (2145). If the ground water was found at a higher level away from the river, it derived its waters from some other source than the river (2146).

Owen B. Stocker, of Wichita, Kansas (2148–2150); William Mathewson, of the same place (2150–2156), and William Finn, of Sedgwick County, near Wichita (2156–2159), each testified in respect to the underflow, the narrowing of the river bed, and the accumulation of islands in the river and growth of trees. The evidence of each, however, in substance and effect, is similar to that of the other witnesses examined immediately preceding them.

Ransom H. Brown, Wichita, Kans. Direct examination (2159):

"I am the Ransom H. Brown who testified for the complainant when it was taking its testimony in chief. I am city engineer of the city of Wichita. As to my having made surveys of the Arkansas river and run levels in Sedgwick and Reno counties since last August, I will say, between the dates of November 14 and December 2, 1904, I ran levels north and south of the Arkansas river at Mount Hope, Kansas, and north and south of the Arkansas river at Wichita, Kansas. The purpose was to check upon levels that were run by Colorado engineers, as I understood it. I had at that time a copy of the evidence of Professor Carpenter given in this case on behalf of the State of Colorado. I ran over the same lines that Professor Carpenter testified that he had run. Those lines are north and south of Mount Hope, and the lines north of Colwich.

"As to the line north of Mount Hope, referring to my memoranda which was made at that time, and which is correct, I will say that I started where the bridge is, across the river just north of Mount Hope and found that there were 3.48 feet of water in the river, and at a point 2,640 feet north of the river we dug a well and there found the water in the ground .7 of a foot above the water in the river. At 2⅝ miles north of the bridge we dug a well and there found the water in the ground 7.82 feet above the water in the river at our starting point. At 4⅛ miles north of the bridge we dug a well and there we found the water 11.32 feet above the water in the river at our starting point. The elevation of the water or depth of the water in the river at the time I made my levels was different from the water that Mr. Carpenter reported. The levels practically agreed with what Mr. Carpenter found as being the height above the levels of the water in the river. These measurements practically agreed in all cases, yes,

sir. Yes, sir, this line was run due north from the bridge at Mount Hope. No, sir, that line is not anywhere near at right angles with the current of the river. It was an acute angle. The river has a course running southeast at about a 45 degree angle without section lines. I took the course of the river and drew a line with the general course of the river and from that line I ran at right angles to strike the point where we dug these wells. Then I ran the levels up the river, and found that the water in the river was on a level at right angles to our wells. The water in the river was on a level with the water in the wells at right angles to the water in the wells. In some places we took the wells of the Colorado engineers, but where their wells had water in them we dug other wells about ten or fifteen feet from them. We found their wells, every one of them (2159), and some had so much water in them that we dug new wells. From my actual measurements, as to how the water stood in these different wells as compared with the water in the river when we measured it at right angles with the river, I will answer, it was on a level, and that continued as far as we went, yes, sir, and we went 4⅛ miles from the Mount Hope bridge. The fall of the Arkansas river through that part of the county varies. Some miles have a fall of 4½ feet, some have a fall of 6 feet to the mile, and the greatest I have found was 8 feet to the mile. In going north on this line from Mount Hope I found some lakes in the immediate section of these wells. As to the location of the lakes, at our well, which was 2⅝ miles north of the bridge, we found two little lakes south of the well—one of them about ⅛ of a mile and one about ¼ of a mile south, and a small lake about ⅛ of a mile west, and a small lake ⅛ of a mile east, and then there was Patterson's lake, which was about one mile northeast. Patterson's lake is, I should judge, about ¾ of a mile north and south by half a mile east and west. Then at our well that we dug at 4⅛ miles north there was Patterson's lake, which was ¾ of a mile southeast, and a small lake half a mile west, and a small lake a mile and a half north. Yes, sir, I took the level of the water in these lakes. As to how the level of the water in these lakes compared with the level of the water in the river when measured from a line drawn at right angles with the general course of the river, I will say, it is above the water of the river. The water in the lakes is above the water in the river. I don't know what is the source of the water in those lakes. (Objection.) They have no inlets, no, sir. I think their sources are from springs. They are surface lakes and are fed to a certain extent from springs. As to the lay of the land around those lakes as to sloping from the lakes or toward them, these lakes are all in what I would call a punch-bowl formation, or a globe. The ground is higher around the lakes. The level of the ground is such that some of the water from rain would drain into these lakes. As to how much higher we found the water in any of these lakes above the level of the water in the river, drawn on a line at right angles from the general course of the river, I will answer, at a well 2⅝ miles north of the bridge the elevation of the water in a lake which was ⅛ of a mile south of the hole was 2.6 feet above the water in the river at right angles to the river. As to how the level of the water in the lake compared with the level of the water in the well, there is 2.6 feet difference between them. The lake is that much higher. That is the only lake I took the elevation of.

"I made some measurements in other directions than on the north side of the river, yes, sir, right close to the bridge. As to how I found the water level in those measurements, I will answer, I found the water level there .13 feet below the water of the river, and the point of comparison was the river at the bridge. As to how that point would be in comparison with a point in the river at right angles to the general direction (2160), I would answer, it would be about half a foot below the water. If the water is supplied to any of those wells from the underflow of the Arkansas river, from my observation and experiments, as to where that water would leave the river, being above or below a point that I designate the point at right angles to the river (objection), I will answer, it would leave it above; that is, it would leave the river above the point at right angles to the river, and this would be on an average of five feet to the mile, I believe.

"Yes, sir, if water came from the river two miles above the point at right angles, it would come at a point about ten feet above the level of the water at the point where I designate it to be at right angles. (Objection.) And that would continue on as we went up the river, yes, sir. Yes, sir, I took each of the wells that Professor Carpenter had previously measured on the line running out north from the Mount Hope bridge, and I ran a line from each of these wells to a point at right angles to the general direction of the river, and I found in each case that the level of the water in the wells was the same as the level of the water in the river at that point, yes, sir.

"Yes, sir, I ran some levels and made some surveys on the south side of the river at Mount Hope. I started at the same bridge and ran south three miles. That runs through the center of the town of Mount Hope. At one mile we dug a well, and we found the water there 1.73 feet below the water in the river at the bridge. At three miles we found the water in the ground 6.04 feet below the water in the river at the bridge. In both of these measurements I am taking the surface water at both places.

"I ran other lines south of the river at Colwich. I ran a level from this well three miles due south of the river at Mount Hope across to the river in a line at right angles with the general direction of the river. I also ran the levels down the river to get the fall of the river from the bridge—to get the elevation of the water at right angles to the point. I found the water in this well three miles due south of the bridge at Mount Hope on a level with the water in the river at a point at right angles to the general direction of the river. I ran a level from the first well south on the line from Mount Hope and in a line at right angles with the general direction of the river, and I found the water in that well on a level with the water in the river at that point. (Objection.)

"Yes, sir; I made a map showing the location of each of these wells and of the points at right angles to the general direction of the river that I have spoken of. In the measurements at Colwich I started at the bridge which crosses the Arkansas river north and east of Colwich, and I ran due north four and a half miles on the section line. These are the lines over which Professor Carpenter ran, and are described in his testimony, and we found his wells. At $\frac{5}{8}$ of a mile north we dug a well and found the water in the well .08—practically one inch—above the water in the river (2161). At $1\frac{5}{8}$ miles we found

the water in the well 3.66 feet above the water in the river. At 3⅛ miles we found the water in the well 7.16 feet above the water in the river. At 4½ miles we found the water in the well 9.64 feet above the water in the river at our starting point, which starting point was at the bridge. My recollection is that my measurements and those of Professor Carpenter practically agreed, that the difference between the elevation of the water in the river and the elevation of the water at those wells, the water being different in the river at the time I took it, and of course he would find it different in the well. I ran a level from each of these wells to a point in the river at right angles to the general course of the river, and I found the level of the water in each of these wells on a level with the water in the river at a point on the line at right angles to the general course of the river. The river runs through there in a somewhat crooked direction. The nearest point in the river to the water in the well 4½ miles from the Colwich bridge is about two miles west of the Colwich bridge, and the fall of the river through there is about five and one-half feet to the mile. It varies. At a point up the river two and one-half miles from the Colwich bridge the level of the water in the river would be about twelve or thirteen feet above the level of the water at the bridge, yes, sir. As to where the water would come from in the river to reach or affect the level of that well 4½ miles north of the Colwich bridge (objection) I will answer, I can't tell what point, but it would be several miles above the Colwich bridge. If it were more than two miles above the Colwich bridge, the level of the water in the river at that point would be above the level of the water in that well. Yes, sir, that would be true in case of each of those wells that I measured. I ran some levels south of the bridge near Colwich, 4¼ miles south; at one-quarter of a mile we found water in the well dug by the Colorado parties 3.01 feet below the water in the river at the bridge; at one mile we found the water 5.28 feet, in a well that I dug, below the water in the river at our starting point at the bridge; at 1¼ miles we found the water in the Colorado parties' well 6.54 feet below the water in the river at the bridge, our starting point; at 2¼ miles we found the water 10.47 feet below the water in the river at the bridge; at 3¼ miles we found the water 12.27 feet below the water in the river at the starting point; at 4¼ miles we found the water in the well 17.12 feet below the water in the river at our starting point.

"I had no records of the measurements made by Professor Carpenter of anything south of the river. I was told these were the Colorado wells by their engineer. I didn't run a level from all of these wells south of the bridge near Colwich to the river in a line at right angles with the general course of the river below the bridge; I just took the levels down the river one mile. I found the water in that well on a level with the water in the river at the point where the line reached the general course of the river at right angles. These are all the measurements that I made (2162).

"Yes, sir, I can make a plat of this map that I have so that the same may be introduced in evidence by to-morrow.

"From all of these measurements that I have made as surveyor, and that I know to be correct, as to the general water level of the underflow on each side of the Arkansas river at the points of com-

parison (objection), I will say that wherever I have made surveys I have found the underflow on a level with the water in the river at right angles to the water in the river. My recollection is that just prior to the running of these levels there was more water in the river than usual, but the water in the river had not changed within a few hours or so before I ran these levels so as to affect the level in any of these wells, and the water in the river had been stationary a sufficiently long time for me to determine the connection between the level of the water in these wells and the water in the river at a corresponding point, yes, sir. (Objection.)

"From my observation and measurements, as to how much the Arkansas river has narrowed through Sedgwick county during the number of years with which I have been familiar with it (objection), I would say I would estimate it in the neighborhood of one-third. It may be a little more or a little less. In some places it has narrowed a great deal and in other places it is less. Taking it on an average, it may be a third of it. In some places it is a great deal more than that. As to the condition of the river channel that is still in existence and in respect to islands and sand bars (objection), there are a great many islands in the river that have been formed there in the last eighteen years since I have known the river, and those islands have grown larger and are now continuously growing larger except during high water, yes, sir. As to the effect of high water if continued for two or three weeks upon these islands, the high water has deposited sand and built them higher in a great many places. Ackerman's island, I should judge, at the present time contains about sixty acres. It now extends south of the Douglas Avenue bridge, I should judge, about fifteen feet. (Objection.) That island extends under only one span of the bridge, I think.

"If sand should be pumped out of the bottom of the river below the Douglas Avenue bridge, as to whether that would affect tht level of the watre in the river at the Douglas Avenue bridge and as to whether it has affected it by so having been pumped out (objection), I will answer, it has not to my knowledge.

"As to the carrying capacity of the river to-day in comparison to the carrying capacity of the river when I first knew it, the water being at the same height as measured from the banks (objection), I will say it is now somewhere between one-half and two-thirds of what it used to be, I should judge. It is materially less, and is at least a third less, anyway. As to what effect it would have upon the bottom lands along the Arkansas river for a number of miles both above and below Wichita if the amount of water (2163) should now come down the Arkansas river that in the early days would have filled the river channel practically bank full as measured from the banks (objection), I will answer, the more water we have in the river the more water we have in the underflow, or what I call the underflow—in the ground. Further answering, I would say the bed of the river is not as deep as it was, and the islands have taken up a great deal of the channel and our banks have narrowed. I know at Douglas avenue there has been about three hundred feet taken out. The river hasn't got the carrying capacity it used to have. If the same amount of water should now come down that used to fill the banks, it would have to break over somewhere.

"As to how far back the amount of water in the river influences the level of the underflow on either side of the river (objection), I will answer, three miles is the farthest point I know of, and it does affect the level of the underflow three miles from the river, in my judgment, based upon my observations. As to how the amount of water in the river affects the cellars in Wichita (objection), I know when we have high water in the river we get it in our cellars, and when the water goes down in the river it goes down in the cellars. No, sir, that does not overflow the banks nor go into the cellars from the top; it comes up; that is the way mine did in my cellar. Yes, sir, the amount of water in the river affects the cellars in the city of Wichita more than one thousand feet back from the river. (Objection.) I know that."

(Complainant's Exhibits A–62 and A–63 offered in evidence.)

Cross-examination:

"Yes, sir, I said that the bed of the river had been filled up some and was higher than it was when I first knew it. As to how high the river was at an ordinary stage in the early days, or in other words, as to how high the banks were, the average height of the banks through this county, I would say there are some places we have no bank at all. It is a gradual slope up. In other places we have banks, but the banks vary from nothing to four or five feet. As to how high the surface of the water would be above the bed of the river when the river was flowing just an ordinarily good stream as when I first knew it, I would say perhaps a foot or a foot and a half of water or two feet. Yes, sir, it is a wide and shallow stream in its nature. As to how much the level of the bed of the river has been raised by the washing in of the sand and dirt from the ploughed fields and lands and other causes, approximately, I would say I should judge somewhere in the neighborhood of a foot and a half here at the Douglas Avenue bridge. I think that is about general clear through.

"If the level of the surface water flowing in the river determines the level of the suface of the ground water or underflow, and if there is any water flowing in the river to-day, as to whether the (2164) surface of the underflow must necessarily be higher than it was when I first knew the stream, I would say it must, yes, sir. Whether the river be low or high, if its bed is a foot or a foot and a half higher than formerly, then if the river controls the level of the water in the ground, as to whether the level of the underflow as I call it should be from a foot to a foot and a half higher with the water at the same stage as when I first knew the river, I should say it must, yes, sir. The stream has been narrowed pretty nearly one-third here in Wichita at the Douglas Avenue bridge by artificial means, yes, sir. I have heard talk to the effect that during the flood of 1904 there was quite general complaint made in the city and a general talk of urging the city government to correct the evils that had been brought about by the narrowing of the main Arkansas river at the Douglas Avenue bridge and other places and the interference which had been had with the flow of the Little Arkansas river, yes, sir. No, sir, I made no plans or suggestions as an engineer of how this condition that has been brought about by the people of the city could be corrected. Well, I believe I did, too. I suggested that Ackerman's island

ought to be taken out for the protection of the city. I don't know of any fixing that is needed by reason of artificial interference with the Little river.

"As to the dry months here, the months of the least precipitation, and as to how September, October, and November would compare with any other three months of the year, I would say that in October and November I have seen the lowest water here, I believe.

"I have been engaged in surveying and engineering work almost ever since I have been here, and I have done lots of work in the city and out of the city and generally all over the country.

"No, sir; I have never taken much notice of the effect of the rainfall upon the level of the ground water, and as to whether I know that the level of the water in the ground differs at different times of the year, even though it be beyond the influence of any flowing stream, I will say it does, when we have had heavy rains; and the ground water is higher after a series of months in which the greatest precipitation of the country falls as compared with any other period of the year, yes, sir. As to whether I know why it was that I chose the months of November and early December, or why I was directed to do so if I did not make the choice, for conducting my investigation as to the level of the ground water at the time following about the driest three months of the year, I would say I do not. I had nothing to do with making the choice. I was engaged to go and do that. They had the money and I was willing to take it, that is all.

"No, sir, there were no times while I was in the field that there were extensive rains, and I don't know of any; no, sir. We were only in the field five days. No, sir, we were not out all the time between that date of November 14 and (2165) some time in December. We were in the field November 14 and 15 and November 29 and 30 and December 1.

"No, sir, I have no notion as to how long it takes water to travel through soil such as that in the locality where I ran these levels a distance of a mile, two miles, three miles, or four miles. I have never made any test of that. I didn't pay any attention to whether there was any particular rise or fall of the river within a week, two weeks, or a month prior to the time when I ran these levels, nor did I pay any attention to the river to know. I just took the water in the river as I found it. I don't know whether there had been any rains prior to that time or not, nor whether there had been any higher water coming from farther west, from any cause, regardless of local rains. My recollection is, though, that there were no sand bars appearing at either bridge, which is usual, which made me think there was a little more water than usual, but the water wasn't deep.

"Referring to Exhibit A–62, the line numbered 1 on the plat represents a line drawn at right angles to the river from the well which was 4⅛ miles north of the bridge at Mount Hope. I only sank the one well at the end of this line No. 1, and I didn't find any wells along line No. 1. I measured the water in the well at the end of line No. 1 the next day after taking the level of the water in the well which I spoke of as having been put down by the Colorado engineers, with which I compared my own well, and these wells which I compared together were about five feet apart. As to why I sank another well instead of taking the level of the water in the well that had

already been sunk, I will say the water was in that well and I couldn't tell whether they had struck a hardpan bottom there and water had been poured in or not, so I dug a new well to see. As to the character of the soil around the well dug by the Colorado engineers, I will say, I know its character from my own well. The water came to the same level as the water in their well, and mine came from the ground, yes, sir. In running this line No. 1 at right angles with the river, I didn't have to cross the private property of farmers. I took my levels on the section lines and carried them across. Yes, sir, if one were sinking a line of wells at right angles from the river, that is, more than one, say a mile apart, they would fall upon the private lands of citizens, between this Colorado engineers' well I spoke of and a point on the river at right angles to the course of the river. They would be exactly a mile apart. Line No. 2, designated on Complainant's Exhibit A–62, is a line drawn at right angles to the river to meet the well which was dug at 2⅝ miles north of the Mount Hope bridge. No, sir, I didn't use the well there that had been used by the Colorado engineers; I dug one right alongside of it. Yes, sir, the water came to the level in the two. No, sir, not at once. We waited there, I expect half an hour. The line designated as No. 1 on Complainant's Exhibit A–62 is a line drawn at right angles to the river to meet the well which is (2166) one and one-eighth miles north of the Mount Hope bridge, and I didn't use the Colorado engineers' well there, but I dug new wells alongside of it. The line designated as No. 1 on Complainant's Exhibit A–62 is a line drawn at right angles to the river to meet the well which was bored at half a mile north of the river, and the figures '3.71,' followed by the word 'water' on Complainant's Exhibit A–62 on the north side of the river represent the elevation in the well which was 660 feet north of the bridge at Mount Hope.

"Yes, sir, the lake I spoke of is designated on the exhibit as Patterson's lake. It is about three-quarters of a mile north and south and about half a mile east and west in size. I can't tell you how deep it is. I never measured it. It is not a deep lake. No, sir, it has no inlet or outlet that I know of. It is just simply a punch bowl or basin in the surface of the country, yes, sir.

"As to whether in running on line No. 1 on the exhibit in a northeasterly direction there is any variation in the level of the surface of the ground from the river to the point designated by the figures '15.16,' followed by the word 'water,' I will say it has a gradual rise from the river to that point, and the surface of the ground at the last point named is six feet above the surface of the water in the river at the end of the line. I can't answer the question as to whether there are depressions or ridges or divides between the point marked '15.16' and the river, or whether it is a gradual rise all the way from the river, because I didn't run the levels on that line. No, sir, I put down no wells on my line No. 1 at any point except on the end of the line fathest from the river so as to determine how deep I would have to go in the soil to reach water. Only that one. No, sir, I made no investigation which would permit of my stating whether or not the surface of the ground water bears any relation to the rise and fall of the surface of the ground overlying it. No, sir, I don't know from any investigations which I have ever made throughout this

section of the country whether there is any marked correspondence or similarity between the surface of the ground water and the surface of the ground overlying it, and I am not in position to state whether or not the surface of the ground water rises with the rise of the surface of the land and falls with the fall of the surface of the land. The only levels I have run have been in the sandy soil. No, sir, I can't tell the difference in elevation between the point at the end of line No. 1 farthest from the river and the point at the other end of the line.

" Yes, sir, taking the portion of the Arkansas river shown upon Complainant's Exhibit A–62, the ground rises as you go away from the river on each side. In other words, the river runs in a sort of depression. The ground rises as we go north and south from the river.

" Yes, sir, I said, in answer to questions propounded by counsel for Kansas, that if you would go up the river far enough you would always find a point which was higher than the level of (2167) the water in the wells at the end of the lines designated on the exhibit as 1, 2, 3 and 4, and my notion was that the water in the river supplied the water in the ground at the points where the wells were sunk, but that it left the river at a point higher up the stream and not at right angles with the stream, yes, sir. Yes, sir, the water in running out from the river farther up to reach the point at the extreme end from the river of line No. 1 would not only be moving down hill with the general drop of the country, but it would all the time have to be contending against a side drop toward the river. There is no side fall at right angles. It will fall with the river. That was my statement. It would fall with the river. As I explained, or tried to, the water that comes to this point will have to leave the river above here and will flow with this river and follow it. Yes, sir, if the water is going to come out at the extreme end of line No. 1 it has got to come from farther up the river, because one of the laws of nature provides that it will not run up hill, and another one provides that it will take, other things being equal, the course of least resistance or the greatest drop, certainly. No, sir, it is not a fact that the extreme end of line No. 1 is higher and that there is a direct fall from the extreme end of line No. 1 to the river at right angles from the river. No, sir, there is not any. On the surface of the ground there is six feet—that is, the ground water will flow toward the river, and the underflow water will flow with the river there, from my notes, that I found. It will flow with it unless it meets with some stratum of sand or gumbo to turn it. Yes, sir, the river itself occupies the depression which at least is bounded by higher ground so far out as I ran the lines on either side of the river, as shown on this exhibit. Yes, sir, my notion is that instead of the water from the river flowing down the river through an invisible stream, or underneath it, that it pushes out under the soil some four miles back at an angle with the river and keeps on a level with it. It flows under that sand. It won't go under the river, because it will go below the level of the water level then. I think there is water all below the river all the way, yes, sir. I think the sand here is about sixty feet deep. No, sir, I didn't make any observation in any of these wells as to the rise or fall of the water in them or as to whether it remained stationary. I never went back to them the second time.

"The line designated as No. 6 on complainant's Exhibit A–62 is a line that I ran at right angles to the river to meet a well bored three miles south of Mount Hope. Yes, sir, I sank that well. Yes, sir, the level of the water in that well was on a level with the water in the river at right angles. I haven't got the elevation of the surface of the ground at the river bank, or the elevation of the ground. Yes, sir, I can get the level of the water, and there is a difference of 28.05 feet between the surface of the ground, and the surface of the water at the bridge (2168). Yes, sir, that is the difference between the surface of the water at the end of the line and the surface of the water at the bridge. I dug this well 31.89 feet deep to water. The surface of the ground at the extreme end of line No. 6 as shown on complainant's Exhibit A–62 is 26.03 feet higher than the surface of the water in the river at the other end of the line. No, I am unable from this data to tell just how deep I dug for water, if I understand these questions. I may have gotten mixed up here on your question on these two lines. As to how deep I dug for water at the extreme end of line No. 6, I will say 27.03 feet. Yes, sir, the level of the water at the extreme end of line No. 6 was on a level with the surface of the water in the river at the other end of it. No, sir, I didn't sink any wells along line No. 6 between the extreme end where I state I sank the well and the river. No, sir, I don't know whether the surface of the level of the ground water rises or falls with the rise or fall of the ground overlying that water between those two points. I didn't run the level over that line, so I couldn't tell you. There is a slough out half a mile south of the river. Yes, sir, it has water in it, and had water in it at that time. The top of the water in that slough was lower than the water in the river. That slough has no name that I know of. No, sir, there were no divides or ridges between the slough and the river; it was a gradual decline.

"In referring to the lines run as shown on Complainant's Exhibit A–63, I will say, from our starting point we found many instances in which the level of the water in the ground was considerably lower than the level of the water in the river. We ran on a line due north and south and the river has a northwest and southeast course. Yes, sir, we started from a point higher up the river. Running at right angles to the river, the ground rises as we go north or south from the river on each side along its course as shown on Exhibit A–63. Yes, sir, the surface drainage of the country is to the river from each side. The end line marked '1,' upon Exhibit A–63, is about three and a half miles from the river at right angles, and the surface of the ground at the end of the line marked '1' is seven feet higher than the surface of the water in the river at the other end of the line, and we sank seven feet deep for water. No, sir, we did not sink any wells along the course of that line between the river and its extreme end where this well is located that I have spoken of. The surface of the ground between the river end and the other end of that line has a gradual slope. There are no sloughs and no ridges, and there are no sloughs between the wells which I sank on the south side of the river and the river, no, sir. No, sir, I didn't sink any inttermediate wells on these lines between the end of the line farthest from the river and the river, and I know nothing as to the depth of the water under the surface from actual observation between the two points on any line. No, sir, I do not (2169). And I do not know whether the water rises

and falls in any of these holes from observation at any one time of the year as compared with another or one week as compared with another.

"As to whether I was asked in this employment to take any levels as to the depth of the water in the wells on the places of Mr. Hansen, N. O. Huss, C. E. Tupper, D. E. Breese, Mr. Rutledge, J. W. Harrison, H. Jorgensen or any of those people who testified in regard to the water level in their localities when Kansas was putting in its testimony in chief last summer, I will say the Hansen well I believe was the only well that was designated by me, and that is one that Mr. Carpenter had spoken of. As to whether I made any measurements of the wells or the water levels spoken of by these various people you have named, I will say it was directly north on a line from the bridge at Mount Hope and south of the bridge at Mount Hope and directly north of the bridge at Colwich and south of Colwich that I checked on, and that is all. If those others you speak of were on that line I checked on all of the Colorado wells along that line. No, sir, not on their own wells. I didn't do that. And that was not part of my employment."

Redirect examination:

"As to the bed of the Little Arkansas river being above or below the bed of the Arkansas river at a corresponding point, I will state that in two places I have run levels connecting them, one at 13th street in Wichita, and I found the bed of the big Arkansas river eight and one-half feet above the bed of the Little Arkansas river. At Twenty-first street my recollection is that it is 13 feet above the bed of the little river. These are practically corresponding points, yes, sir.

"As to the time when I was directed to make these experiments, I will say I know it was immediately after the return of counsel for Kansas from Colorado, and that was what fixed the time of the year for the making of these measurements, yes, sir. Yes, sir, Professor Carpenter's testimony was given on the 17th, 18th, 19th, and 20th days of October, 1904, and I made these measurements the next month following. Yes, sir, when I made my measurements to determine the level of the water in the well, as corresponding with the level of the water in the river at right angles, it was on the same day. We were two days in all. Now, I think north of the river we covered in one day and south of the river we covered in one day. It is my recollection it was all done on the same day. No, sir, we had no trouble in running a line from these extreme points away from the river to the river at right angles and keeping off of private property. We kept to the section lines. As to whether Professor Carpenter could have done the same thing if he had wished to do so (objection), why, it is all open there. He could, yes, sir. I know we did without any trouble (2170).

"In the line directly north from the Mount Hope bridge and also from the Colwich bridge the land has a gradual slope from the river up. The land is a little uneven, but it is not bad. It is a little rolling. As to whether the water level actually followed the unevenness of the surface of the land, or whether the water levels at the different points are on a level with each other or on a grade with each other, I will say, on this line the water was on a grade. It was on a level on the right angle line, and we had no intermediate points. As to how wide the drainage of the river is on each side before it begins to drain in the opposite direction, I couldn't tell you. I didn't

run to the divide. I don't know just where the point is where the drainage begins toward the Little river, but there is a divide, when you reach it, from which the water drains into the Little Arkansas river; and that is also true of the Cowskin on the west. When I had reference this morning to the water flowing toward the river, what I had reference to in referring to the ground water was the surface water on top. As to where I found the sand sixty feet deep, I mean it is sixty feet to rock. This is only hearsay, as I get it from the waterworks company. (Objection.) And what I meant was that from my general information they struck rock here at sixty feet in depth. The levels of the water in the wells from Mount Hope that are marked are based upon a point at the bed of the river at the bridge at Mount Hope and at the bridge at Colwich, on a north and south line. In all the measurements I made I did not find that any variation or unevenness in the surface of the land had any effect upon the level of the water, to my knowledge."

Cross-examination:

"As to whether or not it is true that if Professor Carpenter desired to sink the lines of wells as they were sunk and as I found them, say, from five hundred to a thousand feet or half a mile or a mile apart, and keeping on a line one with another, if he had run at right angles to the river—as to whether he would have been compelled in putting those wells down to trespass on private property or to sink some of them on private property, I would say, if he wanted to put them at an equal distance apart he would have to, but in going on that right-angle line he would have crossed two or three section lines where he could have sunk some wells, but they would not have been equally distant apart. These section lines are all left open. They are on roads. All of these section lines, or pretty nearly all of them, are highways" (2171).

The following-named witnesses were also introduced and examined by complainant at Wichita in rebuttal, and the tendency of the testimony of each, in effect, was that the volume of water in the river had materially decreased during the last ten or fifteen years, as compared with the volume during the ten or fifteen years previous; that the channel of the river had narrowed; that islands have formed in the river and trees have grown thereon; that there is an underflow in the valley of the river and that its level is affected by the rise and fall of the water in the river, viz: F. M. Stambach (2172–2174), C. W. Watz (2174–2176), H. H. Hansen (2176–2178), Rufus Cone (2178–2180), G. T. Cubbon (2180–2182), Joseph G. McCoy (2182–2183), M. E. Morgan (2184–2189), Frank Bridgeman (2190–2196), P. V. Healy (2196–2198), and James Beal (2199–2201).

At Oxford.

W. H. Poovey. Direct examination (2202):

Have lived in Sumner County, Kansas, since 1880. For a number of years lived within a mile and a half of the Arkansas River. Last year lived within two and a half miles. Very little timber on the river up to 1890. The river was wider in the earlier years. There is considerable timber now where the bed used to be. The bed of the river is 200 feet narrower. As to the channel, I can't see any change. Don't think the banks are higher. There are more islands than when I came here, and those that were here are considerably

larger. Don't know of any increase in number. The changes that I have noticed have taken place within twelve years. The flow of the river during the last ten years in comparison with the first ten I was there is lower.

Cross-examination by counsel for Colorado (2204):

Do not think there are any more islands in the river now than during the earlier years. Some have enlarged, and some have become attached to the mainland. There was not much timber along the river when I first came here. There is considerable more now. Think it is an advantage to have the timber increase. If we have a good rainfall, we have a good crop; and if we have a poor rainfall, the crop is poor. Land has advanced in price considerably since I came here. I consider that it has doubled in value in the last five years. The people here are as prosperous now as at any time in the history of the country, and the future of the country is bright for the farmers (2204). I should say the carrying capacity of the river has decreased somewhat in late years (2205).

The testimony of W. L. Shore, examined at Oxford, Kansas (2206–2210), was the same in effect as the preceding witness, with the exception that he adds (2210) that he used to raise better crops on the bottom lands than now; that the subirrigation is not as near the surface as formerly.

J. S. Overley. Direct examination (2210):

Lived a mile west of Oxford and a mile from the river for twenty-eight years (2210). The river has filled up a good deal to what it used to be. Timber has grown up on the river and the banks are not as high. There are more islands. Those that were here when I came have increased in size and grown up with timber. There is less water in the river than formerly (2211).

Cross-examination by counsel for Colorado (2214):

Land has improved some in value in this county during last five years. Perhaps one-fourth. Don't think lands have ever been any higher than now. Think we have been injured by the taking of water from the river by the people of Colorado.

Redirect examination (2214):

The level of the underflow rises and falls with the condition of the river. Have noticed this a mile from the river.

The following-named witnesses were also introduced and examined by complainant at Oxford, Kansas, viz., Jasper Sommerville (2215–2219); Squire Stevens (2220–2222); J. R. Johnston (2222–2224); John Jackson (2224–2226); J. M. Steele (2227–2230); W. F. Mains (2230–2232); Silas Thurlow (2232–2235); A. P. Doughitt (2236–2241), and Jeremiah Patterson (2241–2246). The testimony of each of these witnesses was substantially the same as that of the other witnesses examined at Oxford from which extracts have been made.

At Topeka.

G. W. Veale. Direct examination (2246):

Have lived in Topeka for forty-three years, and in Kansas forty-eight years. Acquainted with the Kaw Valley and its tributary valleys. First experience in the Kaw Valley was in the month of July, 1857. Located land in Pottawatomie County, Kansas, on the Kaw River, in 1857. Owned it to 1887. Am familiar with the state of

crops in the Kaw Valley since coming to Kansas. The valleys tributary to the Kaw are the Republican, the Saline, the Smoky Hill, and the Solomon (2246). The Kaw and the Kansas are one and the same stream. The streams that help form the Kansas are the Republican, the Solomon, the Saline, and the Smoky Hill. Do not think there has been any decrease in the flow of the Kansas River, take it year in and year out, since I first became acquainted with it. There has been no narrowing of the bed of the stream. There has been no decrease in the flow of the other streams named by me as tributary to the Kansas (2247). In the valley of the Kansas River we raise as good crops now as we ever did. If the statistics taken during a long period of years should show a gradual falling off over the State in the yield of corn and wheat and oats per acre, I would attribute this to the putting of the thinner and poorer lands under cultivation. When we first came we seized upon the best lands, which are the bottom lands, and then we went on to the upper lands, and so on until we got the worst (2248).

Cross-examination by counsel for Colorado (2250):

There is more timber now on the streams than when I first knew them. It has been cared for and protected from fire.

Cross-examination by counsel for intervenor (2253):

There were islands in the Kansas River when I came here. One would sweep out and another would form. There are not any more in number. We do not have the wind we had forty or fifty years ago. The floods during the last three or four years have been more destructive than in the early days. I think it is true that by the cultivation of the soil there is more silt in the river and the bed is higher than it used to be. The channel of the Kaw River is much the same as when I came here. There is very little change in the river in fifty years.

Hill P. Wilson. Direct examination (2253):

Assistant secretary of the State of Kansas. Live in Hayes City, Ellis County. Went there in 1867. There is not much difference in the flow of the water in the Smoky Hill and Saline rivers from when I first knew them in 1867. The channels or beds or banks have not changed at all. The bottom lands along these streams are more fertile than the uplands (2254). The bottom lands were first settled upon and taken up (2255). The fertility of the soil in the valley of the Smoky Hill and the Saline and their tributaries in Ellis County are as great now as when the cultivation of the soil first began. If the statistics should show that there has been a great deal of falling off in the yield of wheat and corn in the State, I would attribute it to the cultivation of poor lands. The first settler takes the best lands and the last settler takes what is left, and the best land would be cultivated first. They are now cultivating land that they never dreamt of cultivating in the earlier years (2257).

Cross-examination by counsel for Colorado (2257):

They seem to raise about the same average crops now that they did twenty years ago.

John S. Dawson. Direct examination (2262):

Have lived in the northwestern part of Kansas eighteen years. Have been on the Smoky Hill in Trego and Ellis counties. The Smoky Hill and the Solomon have not decreased in volume during

the last few years as compared with the earlier years. The bottom lands along these streams are as productive as they ever were (2263).

F. D. Coburn, Topeka, Kansas.

Direct examination (2266):

"I live in Topeka, Kansas, and have lived in Kansas a little over thirty-eight years. I am secretary of the State board of agriculture, and have been its secretary nearly twelve years in this instance, and I was secretary twenty-odd years before for a time. Taking it all together, I have been connected with the State board of agriculture of the State of Kansas for fifteen years. All of the volumes of the biennial reports of the State board of agriculture have been published under my direction during that time.

"In gathering the statistics showing the average yield of crops in the different counties, and especially corn, wheat, and oats, as to whether I made any distinction between bottom lands and uplands, I will answer, no, sir. Under our system of gathering these statistics there is no provision for anything approaching that (2266). If these statistics show the average yield for the whole country, as to whether that would indicate how much of that country is either bottom land or upland, I will answer, not in the slightest degree, no, sir. I am familiar with the 14th Biennial Report for the years 1903–4. I made it. And I am familiar with the statistics set out on pages 949, 950, and 951. These statistics were compiled under my direction. As to whether they are reasonably accurate as we could make them, I think they constitute the court of last resort in such matters. The column on each of these pages showing the average yield per acre—on page 949 of wheat, on page 950 of corn and on page 951 of oats—seems to indicate a decrease in the average yield per acre, yes, sir. As to how I explain that decrease in the average yield per acre as shown on these three pages, I will answer, I know of but one explanation and that would be that in the earlier settlement of the State when the immigrants took the choice of all this land they naturally took the land adjacent to the streams, presumably the most fertile and productive, and the earlier statistics are made up from the yields of these more productive lands, and as the State has advanced in years these outlying lands on the hills and slopes have been occupied, presumably the thinner or less desirable lands, and the more of those less productive lands that have been put into cultivation the smaller the general average of a given county would be likely to be. As to whether these statistics of the average yield show that the average yield has decreased and show that there has been a decrease in the productiveness of the bottom lands along any particular river, I will say, not in any wise, no, sir. In making this answer I wish to make it clear there that the statistics as employed in a preceding answer of mine here do not bear upon the productiveness of any particular lands adjacent to the streams as differentiated from any other lands. The productions of these lands are grouped by counties and not by rivers or localities of that character."

(Complainant offers so much of pages 949, 950, and 951 of the 14th Biennial Report of the State Board of Agriculture of Kansas, Vol. XIX, for the years 1903–4, as shows the average yield per acre of wheat, corn, and oats, respectively, of the State of Kansas, being the

column of years and the columns showing the average yield per acre, as follows (2267–8) :)

(Objection.)

Years.	Wheat, average yield per acre.	Corn, average yield per acre.	Oats, average yield per acre.
	Bushels.	*Bushels.*	*Bushels.*
1860			
1861			
1862	21.00	40.00	33.00
1863	16.00	44.00	30.00
1864	16.00	25.00	29.00
1865	15.00	41.00	34.00
1866	21.40	34.20	39.00
1867	14.00	38.60	36.00
1868	15.60	18.00	25.00
1869	18.50	48.40	42.10
1870	15.00	33.00	31.50
1871	15.90	40.00	31.80
1872	11.60	38.50	32.50
1873	14.00	39.10	33.00
1874	13.79	10.25	24.25
1875	17.77	48.80	33.88
1876	14.28	43.68	31.61
1877	13.45	40.38	41.16
1878	18.67	37.13	39.19
1879	10.63	36.29	23.22
1880	10.34	28.53	24.03
1881	9.38	19.33	29.28
1882	22.29	35.36	41.46
1883	19.25	39.14	44.61
1884	21.47	41.99	37.25
1885	8.34	33.67	34.86
1886	8.29	24.05	30.37
1887	6.75	11.60	29.62
1888	14.93	24.13	32.99
1889	22.15	40.15	28.42
1890	12.40	8.84	23.77
1891	15.68	26.75	30.72
1892	18.05	27.74	28.04
1893	4.85	19.20	16.03
1894	5.82	10.45	12.88
1895	3.84	24.00	19.71
1896	8.27	28.03	13.06
1897	14.81	18.34	23.82
1898	13.14	17.54	20.57
1899	8.76	27.48	27.57
1900	17.66	18.25	29.45
1901	16.99	6.33	17.80
1902	8.67	28.80	32.21
1903	15.76	25.95	22.86
1904	11.11	20.33	17.24

"As to whether I can make my last answer any more definite or certain or give any more information concerning the point than I disclosed in my answer, I will say, in view of its probable ambiguity I wish to withdraw that answer and say instead that our statistics would not and do not indicate whether there is an increase or decrease in any crop on the bottom lands as distinguished from others. The smallest subdivision for which we compile statistics of crop acreages and yields is a municipal township, which may be of large or small area, and the varying character of its lands or soils, the areas of each kind, and the crops they produce of each kind are not computed otherwise than collectively. The same system is pursued with reference to every portion of the State, township, county, and State as a whole. As a whole, as to which part of our State was first settled, I will say the eastern portion—the eastern counties. As to which portion of the State from an agricultural

standpoint has the higher productiveness, I will say the eastern portion, especially as to corn and oats. This is possibly not so applicable to the wheat crop."

Cross-examination:

"As to what is the dividing line between the east and west in corn production, I will say, speaking in general terms, corn is not a suitable crop west of 200 miles west of the Missouri river. The State is 400 miles long. The west half of the State I should have said. As to whether that is about Great Bend, I couldn't tell without looking at the map. Corn is not considered a suitable and reliable crop in that part of the State west of Great Bend. I do not wish to be understood in saying that to mean that they do not grow corn in counties farther west, but the corn crop of the State is grown east of Great Bend" (2269).

Thomas Anderson. Direct examination (2269):

Testified in effect that he had been acquainted with the Smoky Hill, Solomon, and Saline rivers for forty-four years. That the average flow was the same now as formerly. That the productiveness of the bottom lands in Saline County was as great as formerly. That the bottom lands were first taken up (2270).

A. M. Campbell. Direct examination (2273):

Live in Salina, Kansas. Came to the State in 1853. Went to Salina in 1858 (2273). First located on the Saline River, then moved up on the Smoky. The Saline empties into the Smoky about four miles below Salina. The Solomon empties into the Smoky six miles below the mouth of the Saline. The bottom lands were first taken up and settled (2274). They were the more fertile. The mean annual flow of the water in the streams named is considerably more than in the early days (2275). The soil about Salina is inexhaustible (2277).

Cross-examination by counsel for Colorado (2279):

First saw the Arkansas River in 1859, just across from the old crossing of the Walnut. I was over there one dry year. They had beautiful corn there and we hadn't any (2280):

Redirect examination (2280):

The corn that I saw growing was in the Arkansas Valley. There was none on the hills. Saw no corn until we got into the Arkansas Valley. We were perfectly astonished. The crops were all dried up in our country. This was 1881 or 1882 (2281).

Cyrus Anderson. Direct examination (2281):

Have lived in Kansas forty-eight years. Am acquainted with the streams west of the 100th meridian to the two northern tiers of counties, viz., the Beaver, the Republican, and the Prairie Dog. The Beaver and Prairie Dog are tributaries of the Republican. The flow of the water in these streams during the last ten years as compared with the years from 1880 to 1890 has been just about the same. Can't say the flow is any greater, but it is more regular. They are not dry as great a number of times. The bottom lands along the streams produce now as well as they did when first settled. The bottom lands were settled before the uplands.

W. H. Mitchell. Direct examination (2282):

Testified in effect that the Solomon River has not decreased in volume since he knew it in 1872; that the bottom lands were settled first; that they are more productive than the uplands (2283).

(8) IN RESPECT TO THE QUESTION OF THE EFFECT THE ALLEGED DECREASE IN THE VOLUME OF WATER IN THE ARKANSAS RIVER HAS UPON THE LANDS OWNED BY COMPLAINANT.

(a) Complainant's Witnesses.

S. H. Thomas. Direct examination (1940):

Am commandant at the Kansas State Soldiers' Home located in Ford County, five miles east of Dodge City. There are about 560 acres there owned by the State. A hundred acres are bottom lands. The flow of the river affects these bottom lands owned by the State to a certain extent. The hay crop is not as good as it used to be (1940). It doesn't have the moisture because the water is not as plentiful in the river as it used to be. The level of the underground water has gone down since 1894 and 1895. Islands have grown in the river since 1895, and these islands have had the effect in flood times of throwing the channel of the river heavily against the Home lands which border on the river. The carrying capacity of the river at the Home is not as great as it used to be (1941).

Cross-examination by counsel for Colorado (1941):

As to how the productiveness of the land at the Soldiers' Home has compared since I have been commandant there, since the year 1900, according to the reports, with what they were for the five years before I took charge, I would say we have a fair turn-out or productiveness of garden vegetables now, because we have resorted to irrigation. We don't have as good a hay crop as we used to. This does not take place every year, however. Some years have a fine turn-out of hay. In 1895 we struck water on the bottom lands at 14 feet. We go down now to something like twenty to thirty feet to get a good strong flow of water (1942).

Robert N. Wright, a witness for complainant, on cross examination by counsel for Colorado (455) stated that the land at the Soldiers' Home was practically all under cultivation. He says: They are raising fine crops there. The alfalfa there is pretty good. I go by there every two or three days. There is a good strong stand of alfalfa there. Think it has been cut twice this season, and the third crop is now growing.

Complainant failed to introduce any testimony with respect to any specific injury to lands owned by it near Hutchinson, Reno County, Kansas, known as reformatory lands, and more particularly described in the amended bill of complaint in the sixth paragraph thereof (68, 69).

(b) Defendants' Witnesses.

John D. Sidlow. Direct examination (1510):

Fifty-eight years of age. Reside at Dodge City. Have lived in Ford County since 1876 (1510). From 1893 for five years was connected with the Fort Dodge Soldiers' Home as quartermaster. They have some grass lands on the border of the river there belonging to the Home. Was well acquainted with the production of those grass lands. Saw those lands before I went there as quartermaster. They were then used as grazing lands. There was always a good cutting of hay on those lands, and that was true all the time I was there. Never heard of those grass lands being rendered less productive be-

cause the water level had fallen. They had good alfalfa there during all the time I was there. Don't remember hearing any complaint or any suggestion that the alfalfa lands have deteriorated on account of the water level being lowered. Think the crops produced there to-day just as good as they ever were. The market value of those lands is very much more than it used to be. The lands at the Soldiers' Home are just as high as they were in the boom days (1512).

William J. Spencer. Direct examination (1524):

Sixty-five years old. First came upon the Arkansas River in Kansas in the spring of 1863. Belonged to the 2d Colorado Inf. at that time. Have been quartermaster-sergeant at the Soldiers' Home at Fort Dodge for ten years (1524). Was next on the river in 1867. Also in 1868, 1869, 1870, and up to the present time (1525). Am acquainted with the hay lands at Fort Dodge Soldiers' Home (1526). I never noticed any difference in the amount of hay that grew there. It was generally about the same one year to another. Never heard any complaint at the Soldiers' Home that the crop of hay on the land had been affected by the rise or fall of the water level. What little crops we are using at the Home have been just about the same as always. If anything, a little better. The land down there is worth more than it was formerly (1527).

(9) THE ARKANSAS CITY WATER POWER COMPANY.

The Arkansas City, Kansas, Water Power Company.

Complainant introduced witnesses at Arkansas City, Kansas, who testified in respect to alleged injury to a power plant at that place by reason of the decrease in the volume of water in the river at that point, viz:

P. H. Franey. Direct examination (367):

Came to Arkansas City in 1880. Began to construct canal in 1881. Takes water out of the Arkansas River about a mile and a half above the city, where it empties into the Walnut. The Walnut is a stream east of the city, and empties into the Arkansas about two and a half miles southeast of the city. It was begun in 1881 and extended in 1886 or 1887. It is fifteen feet wide in the bottom, with a one-and-a-half-foot slope. It was dug to supply power for mill that was constructed after the canal was built (368). The water in the canal has diminished as compared with the amount of water therein during the first ten years (369).

Cross-examination (374):

When the Walnut River gets up high enough to back up on the canal it injures its usefulness for power purposes, and they can't run the mill.

W. M. Sleeth. Direct examination:

Have been connected with the water power company since it was first established in 1885 (388). It furnishes power for flouring mills, electric-light plant and engine factory, and a chair factory. In 1885 it furnished sufficient power for these mills and factory. The chair factory has not been operated for several years. All the others depend upon the water power. During the last ten years there have been times when the plant furnished an insufficient power to these mills. The electric light plant is running nearly all the time. The

flouring mill had to stop because of the lack of water to furnish power. It consumed the greatest amount of power. Should judge the river to be one-half as large as formerly. We supplied this shortage of power by an engine (389).

Cross-examination (390):

We got the maximum power about 1894 or 1895; had plenty of power up to that time, when it began to get short. One of the concerns I have spoken of have quit using the power entirely. They use steam power. They are putting in an engine now, but it is not yet in operation. When the Walnut River is high it very much diminishes the usefulness of the canal for power purposes.

Redirect examination (391):

Suppose the shortage of water power was the principal consideration for supplementing with steam.

L. E. Woodin. Direct examination:

The mills that were built on the canal were: The Arkansas City Milling Company, the Roberts Planing Mill, the Kansas Mattress Company, the Arkansas City Gas and Electric Light Company, the Kirkwood Wind Engine Company, and the Plummer Chair Company. Those that are left are using water power, except the milling company, which is using an auxiliary steam plant during the dry season. Noticed a diminution in the flow of the river more materially about 1893 or 1894 (391). The falling off of the water in the river affected quite materially the receipts from the sale of power from the canal (392).

A. A. Newman. Direct examination (416):

We commenced to dig the canal in the spring of 1881, and it was completed that summer. Additions or extensions were made in 1885. Our engineer told us it would produce a thousand horsepower (417). We leased at one time about five hundred horsepower. The cost of construction to date is about $150,000 (418).

Frank J. Hess. Direct examination (421):

Water power is much cheaper than steam power.

Insurance premiums are higher on plants that are run with steam power than on those which are run with water power.

Cross-examination (423):

Chair factory has been removed from canal site. It failed, but not by reason of the uncertainty of water.

Redirect examination (423):

The injury to our water power in a general way has hurt us.

Recross-examination (423):

Arkansas City is not a common point with Wichita so far as freight rates are concerned. Think that Wichita has a better freight rate on flour and grain than this town. That would surely have some effect on the building up of a town and its business (423). I know that the freight rates on merchandise in and out of town cut a very important figure in the growth and prosperity of a town. It is a fact that Arkansas City has had a disadvantage in freight rates that has worked against us (424).

(10) IRRIGATING DITCHES IN WESTERN KANSAS—WHEN CONSTRUCTION BEGAN—EFFECT ON, OF SUBSEQUENT APPROPRIATIONS OF WATER FROM THE ARKANSAS RIVER IN COLORADO.

(a) Complainant's Witnesses.

Complainant's counsel submitted testimony in respect to certain irrigation ditches in western Kansas and the injury to the owners of said ditches by subsequent appropriations of water for irrigation purposes in Colorado.

Robert N. Wright, of Dodge City, Kansas, on direct examination by counsel for Kansas (449):

Think the first irrigation ditch was taken out in this country in 1884. There were two ditches—one called the Eureka and the other called the Soule. Think the latter was taken out in 1887. They got water in it that year. It was about twenty-five or thirty feet wide at the bottom. It was three to five feet deep. The main ditch was about 75 or a hundred miles long (449). It had a good many laterals. The underflow ditch was taken out in 1888. The Eureka ditch ran alternately for two or three years. Water was running twenty or thirty miles, and they would have a break or something of that kind. For two or three years it ran full of water. It was completed for about twenty-five miles, and partially completed for about forty-five miles. It was about one-half as big as the Eureka ditch (449, 450). The Eureka ditch has been dry for ten or twelve years. The cause of it is lack of water from the river (454).

Cross-examination by counsel for intervenor (457):

Think the Eureka ditch was begun prior to 1889. It heads seven miles above the county seat of Gray County, at a point called Ingalls.

C. M. Beeson, of Dodge City. Direct examination (460):

Am acquainted with a ditch dug on the south side of the river. It heads nine miles above the city. It is about 18 or 20 miles long. It was dug for irrigation purposes. It is 16 feet wide on the top and probably 8 or 10 feet wide on the bottom, and probably 5 or 6 feet deep. It got its supply of water from the underflow. Think it was dug in 1889 or 1890.

M. W. Sutton, of Dodge City. Direct examination (482):

Have lived in Dodge City since 1876. Lawyer. Represent the Eureka ditch. It was begun in 1882 or 1883. It has been absolutely dry since 1889, except four or five miles at the head. My recollection is that it is 40 feet wide in the ground. Don't know how deep (482). Think about 3 feet. Was 100 miles long. Tapped the river near Ingalls, in Gray County (483).

Cross-examination:

Went dry because there was no water in the river. Think the cost of the Eureka ditch ran up into the hundreds of thousands. It was the understanding in this vicinity that if you could get water on these lands for irrigation it would increase the annual production (483). I advised the officers of the company that they were prior in appropriation to the irrigation canals in Colorado and that suit should be brought in the United States court in Colorado to enjoin the later appropriators from taking out water to the detriment of the Eureka ditch (484).

F. L. Pierce, of Lakin, Kearney County, Kansas. Recross-examination (543):

The Amazon Canal is forty or fifty miles long, 22 feet wide at the bottom, and covers several thousand acres of land in western Kansas. I irrigate 300 acres of land from said ditch (543). Speaks of the Great Eastern ditch, which heads in Kearney County, about three miles west of Hartland, twenty-three feet wide at the bottom and 2½ feet deep. He is acquainted with it for several miles. Covers several thousand acres of land (544). Testifies in respect to some other ditches constructed in western Kansas in the years 1882 and 1883 (548).

Jacob B. Stillwagon. Direct examination (552):

We had water from the Great Eastern from 1888 to 1895. Since 1895 we have had some, but not enough to supply all our wants. Think the Great Eastern ditch was commenced in 1880 or 1881 (552). Think the Great Eastern ditch is about 50 miles from the head to the end, and about 32 to 40 feet wide at the bottom and about 3½ to 4 feet deep. Believe it irrigates between 7,000 and 8,000 acres. The years when most of the land was irrigated was from 1889 to about 1890. It is less now than in 1895. The people moved away because they did not get water, the volume of water in the river having decreased (553).

L. P. Worden, of Garden City, Kansas. Direct examination (561):

Began irrigating in 1885. From 1885 to 1890 there was sufficient flow of water in the river to supply all our needs for irrigation. For the last few years, including 1904, we have had very little irrigation except in flood times. The principal ditch in Hamilton County is the Alamo ditch. It was built in 1888 or 1889 (561). During the years 1897 to 1903 I think the ditches got sufficient amount of water for the purposes of irrigation (562).

I. L. Diesen, of Garden City, Kansas. Direct examination:

In Finney County there is the Garden City ditch, now called the Farmers' ditch, and one further west called the Amazon. The Great Eastern is in Kearney County and extends down into Finney County. The Garden City ditch is about 8 or 9 miles long. Think it was dug in about 1879 or 1880. It was in good condition in 1885. In 1889 there was little water. In 1890 about the same as 1889. Since 1890 it has been the same right along (576). There is another ditch here called the Kansas ditch, now called the Farmers' ditch, and sometimes called the Ilinois ditch. It was constructed between 1885 and 1890 (577).

C. A. Loucks, of Lakin, Kearney County, Kansas. Direct examination (594):

There are 3 ditches in Kearney County used for irrigation—the Great Eastern, the Western, and the Amazon. The Western was constructed about 1880. That ditch has been used ever since and there has been water in it at all times when they have been able to secure water from the river. There have been some times when they have not been able to secure water for the ditch (594). During the last five years, excluding 1904, there has been very little water in the river, consequently very little water in the ditch. The same is true of the Great Eastern (595).

James Craig also testified in respect to the ditches referred to by the foregoing witness and that they did not get the same amount of water as formerly (598), as did also E. B. Stotts (605), O. V. Folsom (610), and Millard F. Griggs (611, 612).

W. R. Patterson. Direct examination (612):

Have lived in Garden City and in Finney County since 1886. Superintendent of the Farmers' Irrigating Association, formerly known as the Kansas ditch. Took charge of it in 1887. At that time had a good flow of water. An ample supply for irrigation during the growing season (612). The supply of water was pretty good until 1893. In 1895 had a fair head of water. In 1896 very little. In 1896 to 1904 would have a little run of water, but it would not last very long. It was less, I suppose, because there were more ditches taken out of the river. Prior to 1904 there was not half as much water taken out of the river as in 1887. Attribute this to the ditches in Colorado. During the years from 1893 down to last year the Kansas ditch was almost abandoned, so far as the water is concerned, and it could not get the water supply. I am familiar with all the ditches in Kansas. Worked on all of them. The facts I have testified to regarding the Kansas ditch are substantially the same with regard to the other ditches and the decrease in the flow of the river (613, 614).

Cross-examination (614):

The Kansas ditch was in the hands of a receiver for some time. It didn't hardly pay running expenses. This probably had something to do with its not being kept in repair and not being used for irrigation, together with the shortage of water. There are ditches above the Kansas ditch in Kansas that are later in appropriation that are now taking water from the river.

(*b*) *Defendants' Witnesses.*

Henry Block, Hamilton County, Kansas. Direct examination (1455):

The Alamo ditch became involved in litigation and became somewhat abandoned. It was allowed to grow up with willows and become in such a condition that it was of very little use down as far as my land lay. About three years ago a number of landowners under this ditch acquired it and put it in better shape. There has been water sufficient at the head of the Alamo ditch to supply that ditch during the irrigating season of the last three years.

D. E. Hogbin, Syracuse, Kansas. Direct examination (1469):

There has been enough water in the Arkansas River during the past three years during the irrigating season to supply the lower Alamo ditch with water for irrigation and the flow of the river at the head gate has been ample for that purpose.

B. F. Stocks, Garden City, Kansas. Direct examination (1475):

Lawyer and real estate dealer. One of the organizers of the Farmers' Ditch Company and owner in the Garden City ditch and secretary of the latter company. Have been familiar with them for twenty years. First became interested in them in 1887. They were in fairly good condition at that time and supplied water for irrigation. In 1890 to 1892 became in bad repair. At that time they were in the hands of receivers. From that time until four years ago the ditches became more and more filled up with sediment and less useful until they reached the stage where they were practi-

cally of no benefit (1477). Since these ditches have been put in repair we have not always had sufficient water for the purpose of irrigating lands under them, but, generally speaking, for the last two years we have had (1478).

Cross-examination (1484):

States that it is practically true that covering a period of 10 years back the fact that the water has not been used for irrigation here in these ditches has been due to the fact that they have been allowed to go to decay and neglect; that the condition of the ditches is one of the main troubles. Another was some shortage of the water in the river.

Nathan F. Weeks, Garden City, Kansas. Recross-examination (1494):

States that ditches were allowed to get into bad repair. Nearly all of them were neglected for some reason or other. For a time they were not in a condition to carry water even though there had been water in the river during those periods. One of the reasons the ditches were allowed to get out of repair was that there was not very much of a flow of water in the river. Another was that the revenue was not sufficient to maintain them.

(11) EVIDENCE OF INTERVENOR IN REGARD TO CROP YIELD IN THE VICINITY OF GARDEN CITY, KANSAS.

Elwood Mead (1425):

"* * * During 1904 collected statistics showing yield and value of crops grown by windmill irrigation in the vicinity of Garden City * * *." (Formulated in intervenor's Exhibit No. 16, which here follows:)

INTERVENOR'S EXHIBIT No. 16.

Irrigation near Garden City, Kansas.

VALUE OF CROPS IRRIGATED.

Alfalfa.—The popular impression that alfalfa yields from 5 to 8 tons per acre is entirely erroneous, for the usual tonnage does not run above 4 tons. Three tons is a fair average. The hay brings from $4 to $6 per ton, making a return of $12 to $24 per acre. Deducting $1.50 per ton for labor, the profit on 1 acre is $7.50 to $18.

Beets.—Sugar beets yield on the average, in the Arkansas Valley, about 13 tons per acre. The average tonnage of fields well cared for is much higher, running up to 18 and even 25 tons. The beets raised under windmills are all well tended and bring $6 per ton to the grower ($1 bounty from the State of Kansas), or from $90 to $120 per acre. Deducting $35 per acre for all labor, a profit of $55 to $85 is left (cost of hauling not considered).

Fruit.—Apples, plums, and cherries do well in the vicinity of Garden City, while peaches, apricots, and pears are less in favor, although some very fine peaches were seen in 1904, and several young orchards have been recently put in. Cherries are a sure crop, and in 1904 yielded as high as 200 bushels to the acre, worth $2 to $3 per bushel.

Sweet potatoes.—This crop does exceptionally well around Garden City, the average yield being reported as 100 to 300 bushels per

acre. The price varies from $1.50 per bushel early in the season to as low as 50 cents. The average is given as $1. The cost of the plants and the labor of setting them out is $20 to $30, making the return from 1 acre about $150 to $200.

One 4-acre piece in sweet potatoes was seen that was being worked on shares, the owner to furnish the land, water, seed, and half the cost of planting, and to receive half the crop and half of any surplus plants started in the hotbed. His investment was as follows:

Land, at $60	$240
Plant for irrigation	282
Seed	28
Half planting	21
Total	$571

Returns from one crop:

Half 50,000 plants, at $2 per 1,000	$50
Half 800 bushels, at 75 cents	300
Total	$350

Onions.—The yield per acre of onions was given as 500 to 1,000 bushels, which sell at 2 to 3 cents per pound, returning the generous sum of $500 to $1,500 per acre. The cost of seeding and thinning is $15 per acre. Others give the return as $300 to $500 per acre.

Berries.—A patch of raspberries measuring 0.25 acre yielded $78, or at the rate of $312 per acre.

Cabbage.—The value of an acre of cabbage is given as $200.

Other garden crops.—The return from mixed garden crops is variously estimated at $200 to $500 per acre. A measured one-third acre in asparagus, onions, and pie plant produced in one season $190, or at the rate of $570 per acre.

The value of various crops raised by windmill irrigation may be summarized as follows:

Value of crops per acre.

Alfalfa	$12–$20
Alfalfa seed	17–50
Sugar beets	90–120
Sweet potatoes	100–300
Onions	300–500
Cabbage	150–250
Garden crops generally	200–500

(12) EVIDENCE SUBMITTED BY COLORADO IN RESPECT TO THE AMOUNT OF LAND IN THE VALLEY OF THE RIVER IN KANSAS WHICH IS AFFECTED BY THE SO-CALLED UNDERFLOW.

Louis G. Carpenter. Direct examination (1813–1814):

"The lands affected by the ground water in Kansas in the valley of the Arkansas River constitute a strip of about a thousand feet from the bank. The floods in the Arkansas River as they come down into Kansas do not rise usually more than four feet. Those are pretty good size floods. A flood of from two to four feet would not be apt to cause a rise of more than one-tenth of a foot to five-tenths of a foot in the level of the ground water. Such a rise in the level of the ground water, assuming that the ground water affects a strip on either side of the river a quarter of a mile wide would affect about

72,240 acres along the river in the State of Kansas, assuming, further, that the river is 310 miles long in Kansas, as alleged in complainant's bill of complaint."

(13) EVIDENCE IN RESPECT TO THE AMOUNT OF LAND RECLAIMED OR MADE PRODUCTIVE IN COLORADO BY THE USE OF THE WATERS OF THE ARKANSAS RIVER; THE VALUE OF THE LAND, ITS PRODUCTIVENESS, THE POPULATION DEPENDENT THEREON, THE COST OF CONSTRUCTING CANALS, DITCHES, AND RESERVOIRS, AND THE EFFECT ON SAID LAND, IRRIGATION WORKS, AND PROPERTY IF THE USE OF SAID WATERS WERE TO BE DENIED OR RESTRICTED.

E. R. Chew states that the total amount of land that is actually irrigated from the waters of the Arkansas River in Colorado is 200,520 acres; the total amount that can be irrigated from the ditches already constructed is 318,504 acres; that these figures are taken from the reports of the district water commissioners for the year 1903 (497). The number of acres has not materially decreased since that time (498).

Louis G. Carpenter states that from the reports of 1902 it is shown that 300,115 acres are irrigated in the Arkansas River basin in Colorado; that the main ditches cost nearly four millions of dollars; that the average value per acre is from $60 to $75; that these lands would be worth practically nothing without irrigation (654). Colorado's Exhibit 22, compiled from the census reports of 1870, 1880, 1890, and 1900, gives the counties in the Arkansas River watershed in Colorado by name and the population (656); that the total assessed valuation of these counties is $46,994,809; that there are a number of towns within the drainage basin of said river in Colorado, and that the absolute foundation of their prosperity and of the whole community is based upon irrigation (657).

Dall De Weese, of Canon City, Colorado, states that if irrigation were prohibited here (Canon City) the irrigated region would revert back to a worse condition than it was before irrigation was commenced, and the land would only be good for stock lands (840); that there are 6,000 acres of land under irrigation in and around Canon City, and within a two-mile limit of the post-office there are about 10,000 inhabitants, and that in his judgment about 98 per cent of the number are dependent upon this irrigated district; that the assessed valuation of Fremont County is over six millions of dollars; and that about 80 per cent of this has been created and is dependent upon irrigation (842, 843).

S. W. Cressy, water commissioner in district No. 17, division No. 2, which includes Rocky Ford, Colorado, states that his district covers all land irrigated taking water between the west line of Otero County and the mouth of the Purgatoire; that there are 17,000 acres under irrigation from the Holbrook canal, 18,000 under the Catlin, 9,000 under the Rocky Ford (893); that the crops raised on the land in his district under the canals are alfalfa, wheat, oats, sugar beets, and cantaloupes, and the market value of the land runs from $30 to $300 an acre; and that the average value of irrigated land is possibly $75 an acre; that those that are not irrigated are practically valueless; that if irrigation should stop this land would go back to its original state (894). He says, in effect: Sugar beets have run as high as $42 an acre, and cantaloupes $200 an acre. There are about 12,000 acres of beets treated at the sugar factory at Rocky Ford (895). There

are about 100,000 acres of land irrigated from the waters of the Arkansas River in my district. This land is worth about $50 an acre (899). There are a great many orchards throughout the district—one to two thousand acres. These lands are very valuable on the market. A couple of hundred dollars an acre has been refused (900). There are about 10,000 acres of sugar beets raised here near Rocky Ford. They yield, perhaps, $10 per acre this year, 1904 (902).

George W. Swink (911):

Land values in and around Rocky Ford vary from $25 to $250 an acre; $80 is about the average value. Without a water right they would be worth very little—not more than the Government price of $1.25 per acre. Without irrigation all of our industries would be ruined, country would go back to its original condition, and it would only be a stock country.

Charles F. Evans, connected with the American Beet Sugar Factory, assistant manager (921):

Beet sugar factory erected in Rocky Ford in spring of 1900. This year (1904) we expect the beet tonnage will be between 130,000 and 140,000 tons. The average production of beets within a radius of three miles of Rocky Ford this year will be 15 tons to the acre. The farmers receive $5 a ton for their beets (921). The factory here cost over a million dollars. We propose to erect one at Lamar at a cost of half a million. The one at Sugar City cost half a million. Sugar beets can be raised more perfectly and economically in an arid region where we depend upon irrigation rather than upon rainfall. At the present time we import $100,000,000 worth of sugar from Germany every year (922).

F. G. Curran, agent for the Santa Fe Railroad at Rocky Ford (920):

Incoming and outgoing freight charges in the beet-sugar business for the past year approximated three-quarters of a million dollars. The freight on cantaloupes alone was $175,000, which does not include cantaloupe shipped out by express.

Frank Kreybill, of Las Animas, Colorado (927):

Lands not irrigated are worth $1 to $2.50 per acre. There are about 60,000 acres of land irrigated from Fort Lyon canal. The average value of land per acre is from $45 to $50.

A. E. Bent, Lamar, Colorado (974):

There are about 125,000 acres of land in Prowers County under irrigation. The average value is about $60 to $75 an acre. The lands which can not be irrigated are worth in this locality about $1 to $2 an acre.

W. M. Wiley, manager of the Arkansas Valley Sugar Beet and Irrigated Land Company, states that the company has invested in irrigation enterprises in Colorado two and a half millions of dollars; that there are about 500 farmers under the system he represents, whose houses and improvements represent about $300 per family. He further says, in effect: I am familiar with the Arkansas Valley from Canon City to the State line (1435). The growth in population in the valley is entirely due to agriculture, based on irrigation. Among the larger enterprises in the valley are the Rocky Ford factory of the American Beet Sugar Company, with a capacity of 1,200 tons a day; another sugar factory at Sugar City, with a capacity of 600 tons a day; a sugar factory at Lamar, with 400 tons a day capacity; one at

Holly of 600 tons a day capacity; flour mill at Lamar, which cost $400,000; another at Las Animas, which cost $200,000; another at La Junta that cost $300,000, and three canning factories that cost approximately $17,000. There are also a number of grain elevators (1436).

Elwood Mead (1373):

The flow of the river in Colorado during the irrigation season of 1904 was 934,324 acre-feet (1373). This means that the water flowing in a stream for six months would cover that area one foot in depth (1376). Taking the crops as a whole in the valley of the Arkansas, under eight canals in Colorado, the average return per acre for 1904 was $24.68, and the average crop value for each acre-foot of water used was $9.17. The value of the lands under these canals without irrigation would not exceed the Government price of $1.25 an acre (1377). The total area irrigated in 1904 was 345,175 acres (1373).

Intervenor's Exhibit No. 14.

Approximate returns from eight typical canals in the Arkansas Basin.

Alfalfa, 105,285 acres, at an average of $15 per acre	$1,577,275
Orchards, at $150 per acre (10,650 acres)	1,297,000
Other crops, at $25 per acre (49,780 acres)	1,242,375
Sugar beets, 513 acres, at $30 per acre	15,390
Natural grasses, 1,950 acres, at $10 per acre	19,500
Total returns for 168,178 acres	4,151,540
Average returns per acre	24.68
Average returns per acre-foot of water diverted	9.17
Average depth of water applied, 2.7 feet.	

Canals for which figures were obtained: Amity, Bessemer, Canon City Hydraulic, Colorado or Bob Creek, Fort Lyons, Lake, Lamar, and Rocky Ford High Line.

Intervenor's Exhibit No. 15.

Crops grown in the Arkansas Valley in Colorado.

District.	Alfalfa.	Natural grasses.	Orchards.	Other crops.	Seeded grasses.	Total.
	Acres.	*Acres.*	*Acres.*	*Acres.*	*Acres.*	*Acres.*
No. 10	3,496	677	284	2,421	3,865	10,742
No. 11	5,129	8,813	142	6,483	4,722	25,289
No. 12	6,061	1,671	3,729	3,922	110	15,493
No. 13	1,444	6,348	.....	3,029	1,504	12,325
No. 14	39,408	4,728	5,154	30,594	.....	79,884
No. 15	3,689	1,086	164	640	21	5,600
No. 16	19,118	682	395	4,769	5,280	30,244
No. 17	67,725	1,930	3,618	40,467	171	113,911
No. 18	662	468	13	50	16	1,209
No. 19	5,316	1,269	178	1,916	.....	8,679
No. 67	23,970	820	1,009	16,000	.....	41,799
Total	176,017	28,492	14,686	110,291	15,089	345,175

REMARKS.

District No. 10 embraces Colorado Springs and vicinity.
District No. 11: Leadville, Buena Vista, and vicinity.
District No. 12: Western half in the mountains; eastern half embraces Canon City.
District No. 13: Drainage of Grape Creek, southwest of Canon City.
District No. 14: Pueblo and region north of Arkansas River, in Huerfano County, and eastern part of El Paso County.
District No. 16: Drainage of Huerfano River.
District No. 17: Rocky Ford, La Junta, and vicinity.
District No. 18: Drainage of Apishipa River.
District No. 19: Drainage of Purgatoire or Las Animas River.
District No. 67: From Las Animas to State line.
District No. 15: Drainage of St. Charles River, southwest of Pueblo.

(14) EVIDENCE OFFERED BY AND ON BEHALF OF THE GRAHAM DITCH COMPANY, DEFENDANT.

G. R. Hillyer, direct examination (977):

Have resided in Lamar, Colorado, six years. Knew James Graham in his lifetime. He died in 1899. The Graham Ditch Company is the owner of the Graham ditch. The estate of James Graham is the owner of the stock in that company. It is organized under the laws of Colorado.

The lands irrigated by the ditch are owned by said estate. Some, however, are owned by the State of Colorado and are under lease (977).

There are about 2,680 acres of deeded lands belonging to the estate under that ditch. All the lands belonging to the estate and leased by the State of Colorado border upon the Arkansas River.

The waste water from the ditch flows into the Arkansas River. Exhibit 1 of the Graham Ditch Company shows the Graham ditch, all deeded lands, and the lands belonging to the estate of James Graham, deceased (978).

(15) EVIDENCE OFFERED BY AND ON BEHALF OF THE ARKANSAS VALLEY SUGAR BEET AND IRRIGATED LAND COMPANY.

W. M. Wiley. Direct examination (1427):

Lived at Holly, Colorado, for nine years. It is located on the Arkansas River, four miles west of the Kansas line.

Am manager of the Arkansas Valley Sugar Beet and Irrigated Land Company, which owns what is called the Great Plains water system, which comprises five reservoirs north of Lamar, the inlet canals to them, the outlet canals, and two direct-delivery canals (1427). The company is distinctively a land enterprise, and the waterways were constructed as an incident to the cultivation of land. (This defendant's Exhibit No. 1 offered in evidence.) This map does not show all the lands that the company acquired in Kansas. At one time the company owned 105,000 acres of land in Kansas. The lands which the company owned in the State are shown on the map in red color. There are ninety thousand acres in Kansas—in Finney and Kearney counties. The company owns about forty-two miles of riparian lands on the river, in Prowers County, Colorado. These lands were originally taken up by the "rain-belters," in 1886 and 1887. The whole of western Kansas and eastern Colorado as far as Las Animas was taken up by "rain-belters" as lands supposed to be within the rain belt. There was absolutely no agriculture in the country which could depend on the rainfall, nor is there now (1428). The canals of our company were constructed for the purpose of supplying the necessary moisture to the lands to grow crops. The Amity is the largest canal of the company. It was intended to be constructed to the State line and to cover 105,000 acres of land which the company owns in Kansas. The Amity has been constructed 110 miles—80 in Colorado and 30 in Kansas. It has been operated for the irrigation of Kansas lands (1429). The Arkansas Valley Sugar Beet and Irrigated Land Company's Exhibit No. 2 shows the reservoir locations of that company (1430). The Amity canal was a part of the irrigation of the Kansas lands, and the total

expense in connection with the development was $750,000. At least one-third of the people who settled on our lands came from Kansas; 90 per cent of the population of Holly came from Greeley, Kansas. There is absolutely no farming being done in western Kansas above the ditches without irrigation (1431).

The Buffalo Canal, owned by the company, is 16 miles long in Colorado and eight miles long in Kansas. There are so many laterals that I cannot give the mileage of them. The carrying capacity of the Buffalo Canal is 200 to about 250 second-feet near its head, and it tapers down to about 100 at the State line and 50 in Kansas (1432). There has been invested in the company which I represent about two and one-half million dollars. The market value of the lands now, without improvements, is about $75 an acre (1435). The ordinary flow of the Arkansas River at Holly is 1,000 per cent greater than when I went there in 1896 (1441).

"* * * If the Amity canal did not get the benefit of return waters from up the river, we would lose more than fifty per cent in days and in the quantity of the water which the Amity canal now gets in irrigating seasons or in time of shortage. In 1896 the return waters to the river were so small that the river was a continuous dry bed of sand from the State line to Rocky Ford. As this water has been used on the lands above us for irrigation, it has supplied the river with a constant flow, which has enabled the Fort Lyon, the Amity, and the other canals within that district to get the waters which they needed, which in turn was put onto the land and has returned to the river. The same process which occurred above the Amity canal on the river has occurred under the Amity canal, so that at the present time there is always a good head of water in the river south of Holly, which makes the river practically impassable * * *." We return more water to the river by percolation for the benefit of Kansas by reason of the storing of the storm and waste waters and carrying the same through the Amity canal during the period when it is needed for crops either in Colorado or Kansas than we take out of the river through the Amity and the Buffalo canals during the months of July, August, and September.

I would rather have the Amity canal in command of the flow of water which now passes Holly than to have it in command of the flow which is at the Amity headgate, as I would get more water during the irrigating season. Up to 1900 the ditches in Kansas were to all intents and purposes abandoned and agriculture existed only in some of the river bottoms (1441). About the year 1899 or 1900 the owners of the ditch in Kansas which headed in Colorado about a thousand feet west of the State line, and which ditch is operated solely for the benefit of Kansas lands, cleaned the ditch out and the land under that ditch is now very valuable and under cultivation by irrigation. Subsequently other ditches in Kansas began to be cleaned out and the owners of these ditches found that their supply of water was constantly and rapidly increasing. The loss of water between the Amity ditch headgate and the State line between Colorado and Kansas, if the water were allowed to flow in the river, would be about 15 per cent (1442). The increase in the return waters in late years has been caused by the

use of stored waters by our company. Our storage system began in 1898. Our company claims the right to irrigate our lands under the doctrine of riparian rights, also under the doctrine of prior appropriation. We take no more than is necessary to make our riparian lands fruitful and productive. It is necessary to use the waters to make this land productive (1443). (The Arkansas Valley Sugar Beet and Irrigated Land Company's Exhibit No. 3, introduced in evidence.)

Cross-examination by counsel for Kansas (1447):

The total capacity of our canals taking waters from the river is about 2,000 second-feet (1447). Our canals are operated every day in the year (1448). During the winter months when there is water in the river we take as much as we find use for. The winter run never goes up to the full capacity of the canals. We have never been able to fill all of our reservoirs. During the winter our carrying capacity is greater than the amount of water that we usually get. We find it profitable to take all the water the river will give us, and even then we have not been able to fill our reservoirs. Ordinarily speaking, the regular flow of the river gives us a full ditch for not more than a week or two (1449).

We have the greatest trouble during the summer season of getting a sufficient supply of water for our needs. During a good share of the irrigating season we get as much as we really need. We have enough during the irrigation season to supply our needs coming direct from the river, and we have more every year (1450). The greatest need for water in ous country is in May and June (1452).

(16) EVIDENCE OFFERED BY AND ON BEHALF OF DEFENDANT, THE COLORADO FUEL AND IRON COMPANY.

D. C. Beaman, Denver, Colorado. Direct examination (729).

"My name is D. C. Beaman. I live in Denver, Colorado. Am 65 years of age. I have lived in Denver about 17 years.

"I am acquainted with the Colorado Fuel and Iron Company. It is an industrial company, engaged in the mining of coal and the manufacture of coke and steel and iron products. I have been secretary of the company ever since it was organized, except perhaps one year. The present company was organized in 1892. There are now no general officers other than myself with the company who have general knowledge of the company's history. Some of those who organized and built up the company have died in recent years and other officers have been changed. There are a number of auxiliary companies connected with and operated in conjunction with the Colorado Fuel and Iron Company. They are the Rocky Mountain Coal and Iron Company, the Colorado Industrial Company, the Minnequa Town Company, the Minnequa Land and Water Company, the Mountain Telegraph Company, the Crystal River Railroad Company, and the Colorado and Wyoming Railway Company. That perhaps is not quite all, but they are the most important ones.

"The present consolidated company—the Colorado Fuel and Iron Company—began business in 1892; the auxiliary companies are all later than that, some of them are not more than a year old and some 6 or 8 years old. They have been organized from time to time as the

increased business operations and development of the principal company required. The total capitalization of the Colorado Fuel and Iron Company is $46,200,000. The paid-up capital stock is something over $26,000,000.

"In round numbers the present investment of the Colorado Fuel and Iron Company and its auxiliary companies in the drainage area of the Arkansas river in Colorado is about $30,000,000. This investment comprises 18 coal mines, some 2,500 coke ovens, 2 limestone quarries, and the Minnequa steel plant at Pueblo and part of the Colorado and Wyoming Railway.

"The steel plant investment, I suppose, is in the neighborhood of $12,000,000 or $15,000,000. I know of none west of the Mississippi river that are nearly as large. There are 28 steel and iron mills, and when running at full capacity the finished product is about 550,000 tons per annum. The coal mines at full capacity produce about 3,500,000 tons of coal. The coke ovens 75,000 tons and the lime quarries 400,000 tons.

"The daily capacity of the steel works, which consist of 6 blast furnaces of about 2,000 tons, converter, 2,000 tons, blooming mill, 1,500, rail mill, 1,500, merchants' iron mill, 200, hoop and cotton tie mill, 100, spike factory, 100, bolt factory, 16, casting foundry, 80 (729), pipe foundry, 60, 6 open-hearth furnaces, 650, 40-inch reversing mill, 1,100, rod mill, 800, wire mill, 650, nail mill, 400, sheet mill, 100, black-plate mill, 100, tin-plate mill, 200, making a total of something over 11,000 tons daily.

"That would not seem consistent with my statement of the total finished product per annum, but in these various mills the tonnage is duplicated. For instance, the product of the 6 blast furnaces is pig iron, and that with scrap iron and other material purchased outside goes through these other mills and appears in their finished product, which accounts for any apparent inconsistency in the figures.

"As to the values of these products I could not separate them very well, but its aggregate is approximately shown by the gross earnings for the year ending June 30, 1903, which were $16,653,000.

"The earnings for the present year have been very much curtailed by the strikes in the coal and metalliferous mines, which have been prevailing now for nearly 12 months.

"The number of employés when running full is about 16,000. As to the number of people dependent upon the operations of the company, I have figured it on the basis of what I call dependents on the operations, which is a little broader than the mere families of the employés. For instance, take what we call a coal-mining camp. Everybody who lives there is dependent upon the operations of the mine, because if the mine is shut down the camp will be abandoned, so that the merchants, grocers, teamsters, and in fact everybody there is dependent upon the operations of the company. On that basis I figure that there would be 5 dependents to one employé, which would make about 80,000 persons in addition to the employés, or a total of 96,000 persons dependent upon the operations.

"The pay rolls run about $600,000 a month, and will aggregate in a year something over $9,000,000.

"The operating expenses are about $6,000,000 more, making a total disbursement of about $15,000,000, but that does not include material

bought elsewhere, but simply the expenses incurred in the operations. This money is most of it paid out within the limits of this State.

"In the operations of the company it is necessary to use large quantities of water. This comes from the Arkansas river and its tributaries in Colorado, and from surface water flowing into the reservoirs. There are about 9,000,000 gallons of water used in each 24 hours, of which amount there is about 75% returned to the stream under present conditions. This water is used for steam at the coal mines, for cooling the coke at the coke ovens, for domestic purposes for the people employed there, as well as for those employed at the steel works. It is also used at the steel works for cooling and condensing. The cooling and condensing water is used until it becomes too warm (730), and then it is returned to the river. This amount of water is absolutely necessary for the operation of the company's business.

"The company has acquired farming lands along the river, riparian lands with their accompanying water rights, and the water has been turned into the reservoirs of the company, and the lands to which the water was first appropriated lie idle.

"Sometimes we change the point of diversion, but not generally. In other places, for instance, the San Carlos river, we simply continued the ditches into the steel works reservoirs, and did not change the point of intake at all.

"We have bought about 8,500 acres of irrigable land on the Arkansas and the San Carlos and Purgatory rivers, at a cost of about $335,000, and have changed the use of the water in those instances from irrigation purposes along riparian lands to that for manufacturing purposes principally. We are not now using all the water we are entitled to under our purchases, but the business of the company is enlarging as the years go on.

"We provide a great number of houses for our employés, and the investment for tenement houses in something over $800,000.

"At Pueblo, where we have a large number of employés, a great many of them get water for domestic purposes from the city.

"The Colorado and Wyoming Railway for the last year earned $383,000, while its operating expenses were something over $300,000.

"The water rights which we purchased, nearly all of them, antedate 1865, some of them run as far back as 1861, as we have always endeavored to buy the oldest ones we could find.

"The total amount of water thus acquired, or rather the right to the use of the water, is approximately 90 cubic feet per second of time, amounting to about 58,000,000 gallons every 24 hours.

"Besides ditches, we have constructed 4 reservoirs and have a fifth one under construction. Three of these reservoirs are in Pueblo county, and near the steel works. They have, respectively, the following storage capacity: Nos. 1 and 2, 500,000,000 gallons each; No. 3, 2,700,000,000 gallons. Another is on the Purgatory river, but is not yet completed. It has an estimated capacity of 650,000,000 gallons. The other one is what is known as the Sugar Loaf reservoir, in Lake county, Colorado, near Leadville. This has a capacity of 5,600,000,000 gallons.

"These completed reservoirs are used by the company, except the Sugar Loaf reservoir, which has not yet been used, as we have not yet been able to store a very great amount of water in it on account

of the State engineer, who refuses to let us have it,—perhaps he is saving it for the Kansas people.

"This Sugar Loaf reservoir was established by an act of Congress March 2, 1897, by which the Government set aside a certain area there for the construction of a reservoir. It was afterwards abandoned by the Government (731) and sold under another special act of Congress, to be completed and devoted to the impounding of water from the Arkansas river. It was purchased from the Government by John H. Poole, and we bought it from him, and also some adjacent land. The number of acres I do not now remember, but it is quite large.

"We aim to fill these reservoirs from the flood waters when we can, because we are never sure of the other, and it is our purpose and practice to store as much of the flood waters as possible. It is then used as the company needs it from time to time.

"I think our operations have considerable effect on the equalization of the flow of water in the Arkansas river. If the water had remained to be used on the land which we purchased, I do not think so much of it would have returned to the stream, and it would have been returned at different periods; while under our use of it for industrial purposes there is a constant return flow of about 75 % of, say 9,000,000 gallons per day at present. This flows every day regardless of season or weather or anything of that kind.

"The Colorado Fuel and Iron Company, the present company, was formed by consolidation of the Colorado Fuel Company and the Colorado Coal and Iron Company.

"The Colorado Coal and Iron Company was organized some time in the seventies, and it initiated the steel works at Pueblo, and was also engaged in the coal business. It had previously absorbed 2 of 3 other companies, whose names I do not at present recall.

"The Colorado Fuel Company was organized in 1883. It was engaged in the coal business and absorbed the Elk Mountain Fuel Company and the Denver Fuel Company.

"The consolidation was made in 1892 and immediately after the consolidated company absorbed the Grand River Coal and Coke Company, a coal mining concern on the other side of the range.

"The Colorado Coal and Iron Company was a considerable user of water as early as 1884 or 1885.

"Some of the products of the present company are used in Kansas. I find that during the last year we shipped into Kansas 225,000 tons of coal, worth at the points of delivery exclusive of freight charges, over $350,000, the larger portion of that going to points west of Hutchinson. A very large proportion of the fuel used in western Kansas comes from Colorado, and we furnish probably 5/6 of it maybe more than that.

"I know of no coal mines in western Kansas. Our coal mines are situated with reference to western Kansas as well as any other mines, there being a downhill haul all the way.

"I do not know much about the coal mines in the Indian Territory or in central or eastern Kansas, but I understand that the coal is not as good for steam purposes as the Colorado coal.

"The smelters and other large users of fuel in Colorado get a large percentage of their coal and coke from Colorado mines, and of that we

furnish a very large proportion, much larger than any other one concern in the State (732), probably several times more than all the other concerns in the State. We also furnish coal and coke for the operation of smelters and other industries in Idaho, Wyoming, Montana, Utah, and New Mexico, and some coke even goes into Old Mexico.

"We furnish coal to railroad systems operating in Colorado and some of the adjoining territory. Some of our anthracite coal goes farther west.

"If the water supply of this company were cut off it would close everything down, as neither coal, coke, steel, nor iron could be produced without a considerable use of water, much more in the production of steel, iron, and coke than in connection with the coal.

"As use of water by smelters, reduction works, and other institutions of that kind in the Arkansas drainage of Colorado, I tried to get at that, and what they seem to regard as use of water would amount to about 500,000 gallons a day for the smelters at Pueblo and along the Arkansas river, and at Leadville, but their basis is not a proper one. When they figure on the water they use, they mean that which they take in for steam and purposes other than cooling. They do not count that which is returned. If the amount of water they take in for cooling were included, it would be much larger, but they do not consider at all the water that is returned.

"A great many of the towns and cities along the Arkansas valley are users of coal produced by the Colorado Fuel and Iron Company, but I could not say certainly that most of them were because there are other companies which are also supplying coal. The Victor Fuel Company is the largest of the other producers.

"As to the effect upon the market for coal in case the irrigation of lands in the Arkansas drainage was stopped, I should say it would necessarily devastate the country, reducing the supply which we furnish in proportion to the population driven out thereby, which would be very large. I think the population in the Arkansas drainage, at a rough estimate, is about 175,000. If the country were devastated by the cutting off of the irrigation water, our properties could not be operated profitably, as it would cut down the demand too much to make operations profitable. That is, even if we were still allowed to use water for the production of coal, coke, steel, and iron the effect on the markets within the drainage of the Arkansas by the stoppage of irrigation would be so great that it would not pay to operate these industries. If the lands now farmed by reason of irrigation were devastated by the cutting off of the use of water for that purpose, it would simply make this country a desert. It would go back to the days of cattle raising and the cow puncher."

Cross-examination by Mr. Ashbaugh:

"If the entire water supply of Kansas were cut off, I suppose it would be reduced to the condition it was in when they (733) called it 'starving' or 'bleeding' Kansas. I suppose it would hurt Kansas just as much as any other country to entirely cut off its water supply.

"The Sugar Loaf reservoir is located in the bed of the Lake fork of the Arkansas river, and the dam is right across the bed of the stream, with outlet pipes in the dam to relieve the ordinary flow of water. The reservoir was finished within the last six months. There is some water in it now. There have been no flood waters since its completion.

It has a very large basin and the natural drainage is large, and it has received considerable surface water aside from that which comes down the Lake fork.

"The term 'flood water' is a very broad one, and is often used to apply to any volume of water above the ordinary flow up to even a cloudburst. I do not think that is really a correct definition of the term 'flood water.' My definition of it would be a volume of water exceeding ordinary high water.

"The principal floods in the Arkansas valley this year have been below the Sugar Loaf reservoir.

"We built the reservoir with the intention of taking as much of the flood water as the authorities would let us have until we got the reservoir filled. I think that reservoir is large enough and would take care of any rainfall above it, as it is not filled by a ditch which would limit the amount of intake.

"The reservoirs near the steel works are filled by ditches taken out from the Arkansas and San Carlos rivers, and run into the reservoirs. We usually fill them in the spring or whenever the water authorities permit us to. They take an account of our priorites and the priorities of others and regulate thereby our taking of water. It is practicable to take water through these ditches when it is higher than normal, but not practicable to take all the flood waters, owing to the want of capacity of our canals and ditches. They were not built with a view to taking a very large volume of water. We do find it practicable to take water at high-water periods, but from a cloud burst there is too much water and too much force to be controlled by these ditches.

"The company is a private corporation and has no State or Government help. The auxiliary companies which I have referred to perform some incidental work connected with the operations of the principal company. For instance, the Crystal River Railroad is almost entirely used to haul our coal and coke to market. That railroad is not in the Arkansas drainage, but on the other side of the range.

"Nearly all the traffic on the Colorado and Wyoming Railroad is the transportation of coal and coke produced by us on the Purgatory river. That road brings a very large proportion of the steel works fuel supply to the connecting roads which bring it to the steel works (734).

"Of course we would be perfectly willing to have the use of our products in Kansas increased if we could supply them, and an increase in the population of the Arkansas valley in Kansas would certainly be no injury to the company" (734, 735).

(17) EVIDENCE IN RESPECT TO THE INTEREST THE GOVERNMENT HAS IN THE SUBJECT-MATTER OF THE CONTROVERSY AND IN THE FINAL DECREE TO BE RENDERED IN THE CASE AND THE REASONS WHICH PROMPTED IT TO INTERVENE.

Petition of intervention, in effect, alleges that within the watershed of the Arkansas River, west of the 99th degree of longitude, there are about one million acres of public lands which can only be made habitable, productive, and salable by means of irrigation (236). Of such amount 100,000 acres thereof can be made productive, habit-

able, and salable by irrigation, and when so reclaimed by irrigation said hundred thousand acres will support a population of not less than fifty thousand persons (238). That not less than 60,000,000 acres of public lands within the arid region, which are now unproductive, unsalable, and uninhabitable, can be rendered habitable, productive, and salable by means of irrigation (237–238).

That the policy of the Government is to reclaim all the lands that possibly can be reclaimed in the arid region and to make them productive and salable and capable of supporting a large population, and in furtherance of such policy Congress has enacted the statute of June 17, 1902 (32 Stat., 388), commonly called the reclamation act (237). That a large amount of money has been spent under said act and there is available under it $16,000,000. That the doctrine of riparian rights, as contended for by complainant in its amended bill of complaint, is not applicable to conditions prevailing in the arid region of the United States, and if invoked and enforced in such region the public lands would remain in their present state—unproductive, unsalable, and uninhabitable—and the policy of the Government to reclaim the said lands and make them capable of supporting a large population would be defeated. That the policy of the Government of the United States prior to the enactment of the so-called reclamation act, as seen in the legislation of Congress and the acts of the Executive Departments, encouraged the inhabitants of the arid regions of the United States to use the waters from natural streams for the purpose of reclaiming the arid lands therein, and that there has been reclaimed and made productive in said region not less than ten million acres of land which now support a population of several millions of inhabitants, and that within the watershed of the Arkansas River in the arid region there has been reclaimed about two hundred thousand acres which were formerly unproductive and which now support a population of many thousands (236, 237). That the contention of the State of Colorado, to the effect that by means of its sovereignty it owns all the waters within said State, including the waters of the Arkansas River and its tributaries, if established and enforced, would result in defeating the intent and purpose of the so-called reclamation act and the policy of the Government as seen in this act (239).

F. H. Newell. Direct examination (1265–1266):

Since being connected with the Geological Survey I have paid particular attention to the possibilities of the arid region in this country (1266). Have visited nearly every county in every State and Territory in the arid region. This may be defined as that part of the country in which ordinary commercial crops can not be produced habitually without the use of the artificial application of water. It extends from about the 102d meridian in Kansas westward to the Pacific coast, excepting the wet area of western Oregon and Washington. Up to the present time there have been irrigated upwards of 10,000,000 acres within the arid region, and a population of approximately 3,000,000 persons is dependent upon them. Fifty or sixty million acres may ultimately be reclaimed, which will support an additional population of fifty million. The arid land at present is valueless. By intensive cultivation and thorough irrigation it should rise to upwards of $100 an acre in value under the best

conditions and moderate temperatures. Have been interested in the doctrine of riparian rights and have read the decisions in respect thereto. Under the application of such doctrine not over ten per cent of the present area that is under irrigation could have been irrigated, and its application would practically arrest all future development. Should the irrigated area be confined to lands bordering on a stream or within three-quarters of a mile thereof, future development in the arid region would be arrested. Have studied what is known as the reclamation act. Have charge of the work and of the expenditure of about $30,000,000 under the operation of that act. The application of the doctrine of riparian rights would nullify that act, and it could not be successfully executed if the irrigated area was confined to within three-quarters of a mile from the stream (1267).

On pages 1268, 1269, 1270 1271, and 1272, witness details the irrigation projects in contemplation or under construction under the provisions of the so-called reclamation act, viz., on the Tonto Creek in Arizona, involving an expenditure of between three and four millions, to reclaim possibly 200,000 acres, which, when reclaimed, will have a value of one hundred dollars per acre; the Yuma project in Arizona and California, requiring the expenditure of three million dollars and the reclamation of 80,000 acres of land; the Klamath project in Oregon and California to reclaim 75,000 acres at a cost of $30 an acre; the Gunnison project in Colorado to reclaim 110,000 acres; the Minnedoka project in Idaho, on the Snake River, to irrigate 100,000 acres at a cost of $26 an acre; two other projects in Idaho, one to irrigate 3,000 acres and another several hundred thousand acres; in western Kansas, near Garden City, a project to pump the underground waters to the surface; at Huntley, Montana, near Billings, to reclaim 30,000 acres at a cost of $25 an acre; the Buford project on the Yellowstone, to irrigate 60,000 acres in Montana and 20,000 acres in North Dakota; the Pathfinder, in Wyoming, on the North Platte River; the Lake Tahoe project in California and Nevada, which may reclaim a half million acres of desert land; the Hondo project near Roswell, New Mexico; the Belle Fourche project in South Dakota to reclaim 80,000 acres; the Palouse project in the State of Washington to irrigate upwards of 100,000 acres. Witness also states that as a rule the better lands are on the benches back from the stream (1272). Has taken a great interest in forestry and forest protection. Secretary of the American Forestry Association. Forestry aids irrigation. The production of wind-breaks and shade trees depend upon irrigation (1273).

Cross-examination by counsel for Kansas (1273):

If it should be established that on an interstate stream the upper State would have the right to take all of the water of a stream that falls within her borders, it would necessitate a readjustment of many of the irrigation projects contemplated under the irrigation acts, and in some cases abandonment of certain lands.

Cross-examination by counsel for Colorado (1283):

The vital and highest need throughout the western two-fifths of the United States is to take all the waters from the rivers and utilize them and consume them in irrigation whether the streams are navigable or nonnavigable. The question of the navigation of streams in the United States has become very much less important

in the last twenty-five years (1283). Think Great Bend, Kansas, is about at the 99th meridian. That we regard as practically the limit of the humid region. Then there is a belt of semihumid and then the arid region. As to the semiarid region lying between these two regions, it can be gradually improved by irrigation as well as the arid regions. The tendency of the irrigation of lands is to result in smaller holdings (1284).

Elwood Mead. Direct examination (1366):

Water has a commanding importance in the development of the arid portions of the earth's surface. In the arid region the ability to use streams in irrigation is absolutely necessary to the existence of any considerable degree of civilized life. The Government of the United States is annually expending large sums of money in efforts to promote more economical methods of applying water to crops so as to cause a given volume to render a larger service, and that is true of many of the European countries.

On pages 1365, 1366, 1367, 1368, 1369 witness details the changes that have taken place with respect to the use of water within recent years, which changes were necessitated by the growing importance of the use of water for all purposes, and shows the action that legislative bodies of the countries in Europe have taken with respect to the water question (1367).

The English Government has been making appropriations for irrigation purposes in India always with the idea of preventing famine. Our country, in its policy of erecting reservoirs in the arid region, is to a certain extent imitating England in the erection of tanks in India, which is very old there. Within the last thirty years the irrigated territory in Egypt has doubled, although irrigation there is as old as history. In this country in the beginning of the development of irrigation in the arid region the people who began the work were mostly from the humid portions of the country (1370). They did not realize that the difference in climatic conditions must be accompanied by a corresponding change in laws and institutions in order that we should have a systematic and orderly development, and so the diversion of water was left entirely to private enterprise. We find that the States that are partly humid and partly arid incorporated in their laws the common-law doctrine of riparian rights. The early settlement was in the humid portions of these States, and the laws were enacted almost entirely by the people who were living in the humid sections of these States.

As illustrating this point, the witness named Colorado, Nebraska, California, and Oregon.

In States which are wholly arid legislation was framed by people who had experience in irrigation, and the doctrine of riparian rights was abrogated. In the arid States we have laws providing for the diversion of water for use in irrigation (1371). In all these laws there are two fundamental principles. One is that the one to first utilize the water shall be given the better right. The doctrine of priority is to protect each person utilizing the stream in the conditions existing when he made his expenditure. The other doctrine, which has not been so closely followed in practice, is that each right shall be determined by the amount applied to beneficial use (1372). The doctrine of riparian rights is unsuited to the conditions of the arid

region or the conditions of any region where the water supply is all needed for use, because of the uncertainty that exists as to its application. It seems to me that the doctrine that is now in force throughout the arid region is much better suited to all parts of the country where there are large uses of water and is more likely to protect the rights of all having an interest in that water supply than the doctrine of riparian rights (1377). The doctrine of riparian rights, if enforced, is a restriction on advancement and progress, and the doctrine that prevails in the arid region is in line with advancing civilization. The doctrine of riparian rights is a check upon development both in the arid and humid regions. The doctrine that is opposed to the doctrine of riparian rights is that water, being one of the elements of nature, should be utilized to the greatest possible extent, and hence its diversion or use should be permitted irrespective of the place to which it is applied, whether it is on riparian or nonriparian land, whether it is close to or remote from the stream, with this limitation on diversion, that no diversion will be permitted that will impair any existing right of anyone who has used the water beneficially, who shall be protected in his right to that use. My judgment is that the future development of the arid region is dependent upon the doctrine of the appropriation of waters and their application for beneficial use. I know from my investigations and study of conditions in California that the farmers and irrigators there have not followed the doctrine laid down in *Lux* v. *Haggin*, in which the doctrine of riparian rights was declared to exist in California (1378). In order to provide for the continuation of development in California the so-called Wright Act was passed. To evade the decision in *Lux* v. *Haggin* was the main purpose of that act. As to what are riparian lands is one of the most difficult questions connected with irrigation in California to-day. As a practical question, the entire doctrine of riparian rights has been ignored in California, especially in southern California. I have read the decisions in Nebraska in respect to irrigation and the doctrine the courts there undertook to lay down covering the western part of the State. I am not able to understand how the doctrine laid down by the Supreme Court of Nebraska can be applied and permit the continuance of development that already exists (1379). There are something over ten million acres of irrigated lands in the arid regions of the United States, and there are, approximately, invested in irrigation works in the United States $200,000,000. The irrigated lands support many millions of people. I think between 60 and 100 million acres can be added to the irrigated area. The arid region of the United States has usually been taken as all the territory from the 97th to the 100th meridian on the east to the humid lands on the Pacific coast. Portions of the country east of the 97th meridian are semiarid. The use of water for household and domestic purposes is of primary importance; after that, irrigation. You can find power in some other way, but you cannot provide food in any other way. I would put irrigation as superior to navigation, because of the far greater value that can be gotten out of water, and because navigation is the one use of water where its importance instead of increasing is diminishing (1387). The arid portion of the United States, excluding Alaska and the insular possessions, is between one-third and two-fifths (1388).

Cross-examination by counsel for Kansas (1404):

"* * * I believe that the doctrine of priority of appropriation should prevail * * * in every State, and that the existence of a State line has nothing whatever to do with the meritorious character of that doctrine, and that the principle should be so applied as to protect prior rights—the prior appropriators in the lower State against the encroachments of later appropriators in the upper State."

Cross-examination by counsel for Colorado (1409):

The irrigation of the soil not only increases the number of people that are supported directly by it, but it makes possible the development of other industries by means of furnishing subsistence for those engade in such other industries (1409).

"* * * as population increases and agriculture becomes more intensive the desirability of using streams for irrigation will extend to the humid country just as it already has in the densely populated districts of the Old World, where we have larger sums expended for providing the water supply for irrigation in countries with a larger rainfall than that of the Mississippi Valley than are expended for providing water in this country for the arid region. There is no question but even in a humid country the population that could be supported could be greatly increased if the rainfall were reinforced by the use of the water from the streams as the country becomes densely populated" (1410).

The productiveness of an acre of well irrigated land in the arid region of the United States is considerably greater than that of an acre as nearly similar as possible in the humid region, and there is no question but that irrigated lands will support a larger population per acre by agriculture alone than will the humid country. As a rule, in the arid region water will render its greater service for irrigation when taken from near its source (1411). In regard to the reclamation act, I can not see any other outcome but that the establishment of the riparian doctrine renders hazardous the construction of irrigation works of any magnitude (1414). The doctrine of riparian rights and of prior appropriation are antagonistic. They can not exist together. One places no limitation on the place where water can be used and the other places rigid limitations. The general tendency under irrigation is to the subdivision of the land into smaller holdings (1415). There is no question but that both Wyoming and Colorado would be immensely benefited by the establishment of absolute State sovereignty over the waters of each respective State (1419).

Redirect examination by counsel for intervenor:

While in theory the riparian-rights doctrine exists over the arid portion of the State of Washington, in view of decisions of the Supreme Court of that State, as a matter of fact the water is taken out of the streams without respect to riparian rights. That is the actual situation (1422). While in Nebraska the courts have sustained the doctrine of riparian rights, and made it general in application in the State, as a matter of fact the streams in the western part of Nebraska are being used and diverted in accordance with the law that provides for their diversion under the doctrine of prior appropriation. No attention is paid in actual practice to the decision of the Supreme Court of Nebraska in respect to water. You may take every State where the two doctrines exist and there is just the same explanation (1423).

George H. Maxwell. Direct examination (1164):

Should say "the arid region covers the entire west half of the United States, approximately, west of about the ninety-eighth meridian, with the exception of a strip of land lying between the Cascade Mountains and the upper part of the Sierra Nevada Range and the Pacific Ocean." Think there is about 7,000,000 acres of arid land already reclaimed (1164). Within fifty years, I should say, 150,000,000 acres of land can be reclaimed. The land as it stands now is probably worth about a dollar and a quarter an acre. Some of it is not worth that. If reclaimed, would be worth from $150 to $500 an acre, and would sustain a population of from one to two per acre, directly and indirectly.

Am familiar with the riparian-rights doctrine. The development which has already taken place in the arid region could not have been made under that doctrine if strictly applied, and its application would prevent any further development in the arid region (1165). And it would destroy all communities in many places. Should it be established that the irrigated area in the arid region should be confined to riparian lands, say the first and second forties, its effect would be destructive upon any future development in the arid region and would cause an immense destruction of present development. The application of such a doctrine would render inoperative the so-called reclamation act. One of the questions of prime importance in the arid region is the cultivation of forests. The maintenance of the forests without further destruction is essential to the preservation of the water supply that we now have; and I think the reforestation of areas that have been denuded and the planting of large areas of new forests could be made to largely increase these water supplies. Forestry can be increased by means of irrigation in the arid region. Irrigation makes it possible to produce forests so quickly and of such a fine quality of tree that in a comparatively few years we could produce from newly planted forests enough timber and wood to supply all the needs of this country, if the forests were upon land that could be irrigated so as to get the necessary start. The raising of forests by irrigation for commercial purposes could not be successfully accomplished under the application of the strict doctrine of riparian rights, nor could these forests be successfully cultivated should the irrigated area be confined to riparian lands along the streams.

The doctrine of riparian rights in its strict sense is not now enforced in California. We have some decisions there which have been based upon the riparian doctrine, which are unfortunate, to say the least, for the welfare of the State (1166).

The doctrine laid down in the case of *Lux* v. *Haggin* has been very much qualified by recent decisions, and particularly by the case of *Katz* v. *Walkinshaw* (1167).

Theodore A. Bell, member of Congress from California, member of the House Committee on Irrigation in the 59th Congress:

About a million and a half acres of land have been irrigated in California (1175). About one-third of this is in what is known as the arid belt, and nearly all the balance in the semi-arid belt (1176). There are ten thousand acres of irrigated lands near Riverside, and it supports a population of 13,000. The land there reaches its greatest value and runs up to fifteen hundred dollars an acre. The

average value of irrigated lands in California is about $80 an acre. Twelve or fifteen million acres can yet be reclaimed in California, provided that the flood waters which now go to waste could be utilized. Estimates have been made that thirty million acres can be made subject to irrigation in California. The value of the nonirrigated land at the present time in the semi-arid region is $15 to $20 an acre. With water upon them they would easily be worth from $100 to $150 an acre.

"The strict application of the doctrine of riparian rights would very materially affect the development of our State. * * * The strict doctrine of riparian rights has never been applied to California, though the supreme court upheld that doctrine in *Lux* v. *Haggin*." Our supreme court now decides every case upon the facts and particular conditions and circumstances concerning it (1176). The doctrine of riparian rights as laid down in the case of *Lux* v. *Haggin* of necessity has given way to the circumstances and conditions of the State generally. I think the strict application of the doctrine laid down in the case of *Lux* v. *Haggin* would have interfered with the future development of the State. It is irreconcilable with the fullest use of the water for beneficial purposes.

"* * * Should the irrigated area be limited and confined to riparian lands, or, in other words, to the first and second forties bordering on the stream, the effect would be to reduce the opportunity for development from 100 to 500 per cent" (1177).

Cross-examination by counsel for Kansas (1177):

I am not aware of any case in California where the court has overruled the doctrine in *Lux* v. *Haggin*, but the doctrine there stated has been very largely modified by subsequent decisions. The courts, however, have decided the questions broad enough so that they might take up each case and decide it according to its own peculiar circumstances and conditions. Our Supreme Court has recognized the different physical conditions in different parts of the State and have a desire, of course, to put the waters of the streams to the largest beneficial use.

Cross-examination by counsel for Colorado (1178):

This uncertainty with reference to the law as laid down by our supreme court has had the effect of retarding the development of California to a considerable extent by irrigation.

J. C. Needham, member of Congress from California. Direct examination (1203):

A large part of the property in California, in my district particularly, has been created and exists by irrigation. Fresno and Kings counties are in my district.

"Prior to the development of the irrigation possibilities of this county it was largely given over to sheep and stock raising and some wheat raising, and then when the people there learned that they could use water for irrigation purposes they did so, with the result that the value of all kinds of property doubled and trebled, and in some instances it has gone up many times its former value."

The lands before they were irrigated were worth about a dollar and a quarter to five dollars an acre. Those lands which are now irrigated have a value of not less than $100 an acre, and the lands which are prepared for irrigation are worth $50 an acre. It is worth

$100 an acre to be put in alfalfa; and then if it is in vineyards for raisins or fruits it would be worth all the way from $150 to $500. By storing the flood waters in the mountains we could double the irrigated lands in Fresno County. It has been necessary to depart from the doctrine of riparian rights in order to bring about the development in Fresno County which we now have. No future development could be made under the application of such a doctrine. If we were to confine the irrigated area to within one-half and three-quarters of a mile from the center of the stream I do not think it would be too strong to say it would almost destroy development (1203). Am acquainted with the doctrine laid down in *Lux* v. *Haggin* by the Supreme Court of the State. It has been departed from by the courts recently. When that decision was rendered they did not realize the value of water, and as the irrigated area grew the people realized that they could not follow that doctrine and develop as they ought, and consequently the decision itself has been next to reversed. The doctrine of prior appropriation and the application of water to beneficial use is in effect the doctrine that is now in force in California, and that is illustrated in our Wright law, which the legislature has enacted (1204).

Cross-examination by counsel for Kansas (1204):

I have been out of practice for six years, and cannot now name any decision of the Supreme Court of the State of California which intimated that the court regretted the decision in *Lux* v. *Haggin*, but I could find it.

Cross-examination by counsel for Colorado (1205):

"At the time of the decision in *Lux* v. *Haggin* I meant to say that the court did not at that time appreciate the development of irrigation in the State, and the developments subsequently to that decision have shown that the water is more valuable than the land in some instances." Productiveness of lands is very much increased by what is called intensive farming in the irrigated sections. In some localities where they raise vegetables a few acres will support a family. "It is generally supposed that a man would prefer to have forty acres of irrigated land to one hundred and sixty or even more land in the humid regions of California. Crops are a great deal more valuable in the arid region, and experience teaches that irrigation tends to reduce the number of acres held by each individual very greatly. The tendency is to smaller holdings and to increase the population very rapidly."

Redirect examination (1206):

"It is practically true that since the decision in *Lux* v. *Haggin* it has been conclusively shown that the application of that doctrine to the State of California would practically have prevented any further development along agricultural or horticultural lines. It is true and has been demonstrated in California, that there is an irreconcilable conflict between the doctrine of riparian rights and the doctrine of prior appropriation and application to beneficial use of the waters of the streams of the State. No, sir; it is not possible that these two doctrines can exist in the same place at the same time. Of course the decision of the Supreme Court necessarily applies to the whole State. The locality which gave rise to the case of *Lux* v. *Haggin* is Kern County." There was very little irrigating done at the time that decision was rendered. Since that time the irrigated area has grown wonderfully.

Louis G. Carpenter (1829):

According to the 12th census, the acreage of improved land in Colorado is 2,273,968 acres. In Massachusetts and Connecticut the acreage of improved land is given as 2,357,000 acres. The improved land in Colorado is a little short of that in Vermont. It is one-half more than that of Florida. The same census gives the area of irrigated lands in the United States as 7,500,000 acres (1829). That is almost as large as all the improved land in New England, which footed up, in 1900, to 8,134,000 acres. The irrigated land in the West has increased very much within the last five years (1830).

T. C. Henry. Direct examination (694, 707):

I would estimate the improvements on the lands reclaimed by Colorado to be worth about $100,000,000. If Colorado should be deprived of the use of the waters of its streams for the purpose of irrigation these lands would certainly eventually lapse into their original condition of sterility and barrenness and have no value beyond a grazing-land value.

Clarence T. Johnston, State Engineer of Wyoming (1022):

Have had 16 years' experience in different kinds of work connected with irrigation. Was in Egypt for three months making a study of it (1022). About 1,100,000 acres of arid lands have been reclaimed in Wyoming up to date, valued at $30 per acre. About 4,000,000 more could still be irrigated. The total value of this land when irrigated would probably amount to $150,000,000 and would support a population of between 800,000 and 1,000,000.

Am familiar with the doctrine of riparian rights. Under that doctrine it would have been impossible to have reclaimed the lands in Wyoming, and should it prevail it would prevent future development largely by means of irrigation. Am also "familiar with the doctrine which by some is considered a modification of the riparian-rights doctrine which prevails in California, Oregon, and Washington, and which has recently been invoked in Nebraska. I do not think such a doctrine is applicable to the conditions prevailing in the arid region, and where the modification is made it seems to me it is in a way recognizing the doctrine of appropriation as soon as the water is used." The application of the doctrine of riparian rights would prevent irrigation development almost entirely under the so-called reclamation act. The application of the so-called modified doctrine would largely affect the development in the same way.

Under the act of August 18, 1894 (27 Stats., 372, 422, sec. 4), known as the Carey Act, sixty thousand acres have been reclaimed in Wyoming up to the present time and five hundred thousand acres of land are in process of reclamation (1023). The application of the doctrine of riparian rights in Wyoming would almost absolutely impair the value of this act.

Forests can be successfully cultivated in the arid regions and particularly in Wyoming by irrigation. Do not think forestry could be successfully developed in the arid region without the aid of irrigation, except in regions properly adapted to it. If the doctrine of riparian rights were applied in the arid region it would undoubtedly limit the development of forestry therein probably ninety-eight per cent of the possible development (1024).

Cross-examination (1027):

"* * * I mean by the doctrine of appropriation that doctrine which is recognized in the arid States as the appropriation and application of water to beneficial use, the first in time being the first in right according to use. By the modified riparian doctrine I mean that doctrine which, still recognizing the old riparian-rights doctrine, has modified it to the extent of permitting those owning lands abutting on a stream to use water from that stream on which the lands abut for the purpose of irrigation, and I understand that our doctrine of appropriation, as used in Colorado and Wyoming, is that we may use waters from a stream to irrigate lands even though they do not abut on the stream * * *.

"* * * In a State where the land of one-half can be made productive only by irrigation and the other half is productive without irrigation, undoubtedly the doctrine of appropriation, if they could only recognize one, would be of the greatest benefit and the one that should prevail.

"My observation has been that the best agricultural regions are those where irrigation is practiced. Other conditions being equal, irrigated lands will support the larger population, and that fact is demonstrated by the irrigated sections of the Old World, as well as by those in this country. Irrigation has not reached its highest stage of development in this country; it has just begun. There are sections of the Old World where they have progressed much further. Egypt is one place where a better and more economical use and a larger yield is obtained from the water applied, as they make the same amount of water go further and produce larger results. The use of irrigation encourages and leads to intensive cultivation, and it also leads toward dividing the lands up into smaller holdings."

Redirect examination (1032):

The assessed valuation of Wyoming is about $46,000,000, which is about thirty per cent of the real value. Directly and indirectly sixty-five per cent of this is based upon irrigation. About seventy-five per cent of the value of the property in the arid region is based upon irrigation. It runs higher elsewhere than in Wyoming (1032).

"The four million acres of land which I said could be irrigated yet in Wyoming is largely public land. In my judgment it can not be made profitable and inhabitable without the application of the waters of the streams of that State. It is impossible to make it inhabitable and profitable without the application of the water" (1033).

Nellis E. Corthell, of Laramie, Wyoming (1034):

Have been a practicing lawyer for twenty-one years. Have been in every county in Wyoming. Have been in Wyoming for twenty-five years. Have given the subject of irrigation attention. When I came to Wyoming there were about twenty thousand people there. There are about six times that number now. Three-fourths to four-fifths of that population is sustained directly or indirectly by the irrigation of the land. Think that ten million acres is not an extravagant estimate of the lands which may be irrigated in Wyoming. Think 40 acres of irrigated land will support a family of five directly, and about seven and one-half persons indirectly (1034).

Think I understand what is meant by the doctrine of riparian rights. As I understand that doctrine it allows a reasonable use of

water for irrigation for riparian owners on the stream and some reclamation would be possible under the application of such a doctrine.

Understand the doctrine laid down in *Lux* v. *Haggin*, which prevails in California, and the doctrine laid down in Crawford Company against Hathaway in Nebraska. The application of the doctrine so laid down to the arid region would very seriously affect the future development therein by irrigation. "It is hardly conceivable that under that doctrine the Government or any one else would invest vast sums of money in the storage of water that they might be compelled to turn down the streams on the complaint of any lower appropriator" (1035).

Cross-examination (1042):

The average value of the irrigated land in Wyoming is from $50 to $60 an acre. If these lands were deprived of water for irrigation there are not many towns or cities in Wyoming that could exist.

Gibson Clark (1047):

I am a lawyer. Came to Wyoming in December, 1866. There is about from five to ten million dollars invested in irrigation ditches and reservoirs in Wyoming. Forty per cent if not more of the property valuation in Wyoming is due to cultivation of lands by irrigation (1047). There are in the neighborhood of sixty-five million acres of land in the State and at least fifteen per cent can be reclaimed by irrigation, which would be worth about $30 an acre on an average, and would support a population of a million people. Wyoming has now a population of about 120,000.

Without irrigation it would have been utterly impossible to have created the property which now rests upon irrigation in Wyoming. If the doctrine of riparian rights were invoked and sustained there it would have the effect of absolutely prohibiting the future development of the State either by individual enterprise or by the Federal Government under the reclamation act. The existing population would have to get out. Probably twenty-five per cent would have to leave. It is not feasible to make either the reclamation act or the so-called Carey Act effective under the doctrine of riparian rights (1048). Lands lying farther from the streams and on the high lands above the immediate valley of the stream are the ones upon which you can get the best results to be obtained from irrigation (1049).

J. A. Van Orsdel, Attorney-General for Wyoming. Direct examination (1055):

Should say that from 35 to 40 per cent of the property valuation of Wyoming has been created by and rests upon the appropriation of the waters from streams and the application thereof to beneficial use. Five or six million acres of land in Wyoming can yet be reclaimed. When reclaimed they are worth about $20 an acre. Lands which can be irrigated in Wyoming would support directly or indirectly a million to a million and a half people. A forty-acre tract of land well irrigated will support a family of five persons. Under the doctrine of riparian rights it would not have been possible to have brought Wyoming to its present development. The application of that doctrine would have been very destructive to the future development of the State.

Frank W. Mondell, member of Congress from Wyoming. Direct examination (1179):

Member of the House Irrigation Committee. Resided in Wyoming since 1887. At that time there were about 200,000 acres under irrigation. There is now about 2,000,000. About 5,000,000 acres can be reclaimed all together. The land which is not irrigated is now practically valueless, worth in its raw state about $1.25 an acre. If it should be reclaimed by irrigation, it would be worth on an average of $40 an acre, and two and one-half acres of irrigated land will directly and indirectly support one inhabitant. I should say possibly sixty per cent of the assessed taxable property in Wyoming has been created and exists by reason of irrigation. If the waters of the streams were allowed to run undiminished and unobstructed, the lands in Wyoming which have already been irrigated could not have been reclaimed; and should that doctrine be established, the lands would return to their arid state. About sixty-five per cent of our people in Wyoming now depend directly and indirectly upon these irrigated lands. Should the irrigated lands in Wyoming be confined to lands adjacent to the stream—that is, the first and second 40's—the effect would be to almost totally destroy the already irrigated area, and it would curtail future development by reclamation at least ninety-five per cent (1179).

"The committee of which I am chairman in the House reported the bill which is now known as the reclamation act. * * * I was a member of the committee of seventeen that framed the bill and was a member of the House committee that reported it." In the discussion by the committee of seventeen (the committee of seventeen was composed of members of the House and of the Senate) it was assumed that the doctrine of riparian rights would not and did not apply generally to the portions of the United States to which the act was meant to apply. As I understand, the doctrine of riparian rights, if rigidly enforced, would be fatal to irrigation to any extent. The reclamation act could not be made operative in a territory where the doctrine of riparian rights exists and is in force and effect.

"Should it be held that the irrigated area must be confined to the first and second 40's bordering on a stream, I do not believe there is a project in the United States that could be carried out under the reclamation act. I think that probably three million acres of land may yet be reclaimed in Wyoming under the provisions of the national reclamation law." The establishment of the doctrine of riparian rights would be fatal to the operation of the Carey Act in Wyoming (1180).

Cross-examination by counsel for Colorado (1184):

The committee of seventeen that I spoke of was an unofficial committee. It consisted of one member from each of the arid States and Territories with the exception of Wyoming, and she had two members on the committee, Senator Warren being chairman. The States represented were Arizona, California, Colorado, Idaho, Kansas, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oklahoma, Oregon, South Dakota, Utah, Washington, and Wyoming.

The committee of seventeen understood that the doctrine of riparian rights did not apply to the arid States in full force and effect. Some of the committee in the House were representatives of some of the

humid States. A minority report was filed in the House by Mr. Ray, of New York, and Mr. Jenkins, of Wisconsin, based upon a lack of knowledge of the general law of diversion, the doctrine of appropriation of waters.

Francis E. Warren, United States Senator from Wyoming. Direct examination (1289):

When I first came to Wyoming, in 1868, there was no development of any consequence along horticultural and agricultural lines. Since then there has been considerable development along those lines. I can not conceive of scarcely any business which could exist without irrigation. Even the development of our mines must have irrigation behind it. Irrigation has not reached its highest development in Wyoming. More than one-tenth of the area of Wyoming can be irrigated. This would more than quadruple the number of people. With intensive cultivation five or ten acres of land is plenty for the support of a family (1289). I was a member of the committee of seventeen that adopted and reported the so-called "reclamation act." I was chairman of the committee. It applies to the whole arid region. If the waters in the streams of Wyoming should be allowed to flow unaffected and unobstructed it would render the operation of that act in Wyoming practically nugatory (1290). If the irrigated area should be confined to the lands within half or three-quarters of a mile of the different streams, in my judgment it would render the act altogether impracticable. I have been all over the whole arid region, more or less. In a general way the physical conditions which exist in Wyoming prevail generally throughout what is known as the arid region (1291).

Cross-examination by counsel for Colorado (1292):

The tendency of irrigation is to smaller holdings of land. Most crops produced through irrigation are very superior to those produced otherwise. For instance, in the crop of oats, where 32 pounds is the accepted legal weight of a measured bushel, in an irrigated country they go forty pounds and upwards. The same is true of wheat, and you can raise finer potatoes than I have ever seen raised without irrigation. Nearly all the grains and vegetables are not only larger in yield, but more weight to a given measure.

Redirect examination (1293):

I consider irrigation, of course, the paramount use of water in the arid regions. Was raised in Massachusetts, and was brought up on a farm.

I believe the results from the reclamation act would be larger than the results of any economic problem we have solved or had under consideration or have conceived of as being of an impending nature in this country (1294).

Joseph M. Carey, ex-Senator from Wyoming (1324):

Have resided in Wyoming thirty-five years. When I first went there it had a population between ten and eleven thousand; it has now over 100,000. When I went there I think it had taxable wealth amounting to five or six millions, which was largely belonging to the Union Pacific Railroad Company. The taxable wealth for the State now would probably be about one hundred and fifty millions. The assessed valuation is about forty-one millions (1324). This taxable wealth is largely dependent upon irrigation. I believe that

we could add to the irrigated area in Wyoming by using the unused waters of our streams and by reservoiring the flood waters, between four and five million acres. I believe that within one hundred years from now these States in the arid region, if there are no decisions adverse to the use of the water that they appropriate, that a very large acreage will be brought into bearing, an acreage that will compare very favorably with the acreage of such States as Pennsylvania or the States in the extreme east that can not be said to be the greatest agricultural States. Four or five millions acres of irrigated lands in Wyoming would carry a million or two million. The unreclaimed land has no positive value now. The unreclaimed lands in Wyoming, if irrigated, in twenty to twenty-five years from now will be worth $50 to $150 per acre.

I understand what is meant by the doctrine of riparian rights. If this doctrine had been enforced in Wyoming, do not believe that there could have been any development along agricultural and horticultural lines in the State in their entirety. Could not have reclaimed the lands at all by irrigation if that doctrine had been enforced; very little development could be made in the future under such a doctrine.

If the irrigated area were confined to the lands bordering on the stream, within half or three-quarters of a mile thereof, the percentage would be about two per cent. The future of the arid region depends upon the water in the streams and the use thereof for irrigation purposes (1325).

Am the author of what is known as the Carey Act. This act was passed by Congress August 18, 1894. In Wyoming there had been between five and six hundred thousand acres segregated under that act and a large amount of money has been invested in it. The operation and success of that act depends upon the taking of the water out of the stream and applying it to the lands for irrigation purposes. The doctrine of riparian rights, if enforced, would destroy the effect and purpose of that act. It would also affect and destroy the purpose of the reclamation act (1326).

Recross-examination by counsel for Colorado (1331):

The highest duty of water is found in its use near the source of the stream. The tendency of irrigation is to divide the land up into smaller holdings.

In our country up here the farmers want from forty to eighty and one hundred and sixty acres upon which to support a family. But I believe that a forty-acre tract with a good water right is sufficient to support any ordinary family, say, of five—that is, in ordinary agricultural crops (1331). To generalize, the development which has been made in the arid region of the United States and that which is to be made depends almost entirely on the utilization of the waters of that region for irrigation. I do not think there is any doubt about it. The enforcement of what is understood as the strict riparian doctrine, or even a limitation of the use of streams to a strip within a mile of the banks of the stream, would practically ruin the development of the arid region that has already been made and prevent future development. So far as the streams of the arid region are concerned, I do not know of any possible use to which they can be put, either of commerce, navigation, or other means, that is in any degree as im-

portant as their use in the reclamation of the lands in the arid region through which they flow. But an incidental question arises, and that is, the power that is bound to be developed on the streams. Power can be developed in connection with irrigation, and fortunately it does not conflict with the use of the water for irrigation" (1332-1333).

Redirect examination:

The production from an irrigated acre of land in the arid region is very much larger than in the humid region. I have harvested from an irrigated acre 70 bushels of wheat. My father owned land in the State of Delaware, and, fertilize it as highly as he pleased, I never knew him to raise twenty bushels to the acre. We can raise here at times enormous crops of small grains and more per acre than back east, where they depend upon the rainfall (1334).

Miguel A. Otero, Governor of New Mexico (1076):

The assessed valuation of New Mexico is in the neighborhood of $41,000,000. This is about one-fifth of its real value (1076). Two-thirds of this property valuation has been created by the use of waters from the streams for irrigation. Between two and three million acres can yet be reclaimed. When reclaimed it would be worth from 25 to 250 dollars an acre, depending upon the location and the opportunities to market the products. A good deal of this land which can be reclaimed is Government land—four-fifths of it perhaps. It is now worth from forty cents to a dollar and a quarter an acre. If they put 3,000,000 acres of land under water here I think it would support over a million people, considerably over that in this Territory—New Mexico. Irrigation has been practiced in New Mexico for between two and three hundred years. There are ditches along the Rio Grande two and three hundred years old (1077). The establishment of a doctrine which would prevent the taking of water from the streams for irrigation would be absolutely ruinous to New Mexico if enforced, and the same would be true of all the arid region (1078). Lands that are now under irrigation in New Mexico are worth on an average of from $25 to $100 an acre, and some go as high as $250 an acre. Some lands under irrigation in the Pecos Valley have sold as high as $500 an acre (1079).

Luther Foster, President of the Agricultural College of New Mexico (1079, 1080):

Have made a study of irrigation for many years. Irrigation is only in its beginning. Think that the whole property of New Mexico is dependent upon irrigation—more than one-half, at least—if you excluded the stock interests. From six to eight millions of acres can yet be reclaimed. Its value now is about $1.50 an acre. When reclaimed it will be worth a hundred dollars an acre. A forty-acre tract of land will support a family of six directly, when irrigated (1080). If the United States Government should pursue the policy which is now outlined under the reclamation act of 1902, a large development of very useful and highly cultivated land in this Territory would result. This policy is not only a wise one, but an exceedingly practicable one (1082).

Thomas B. Catron, ex-Delegate in Congress from the Territory of New Mexico (1091):

Came to New Mexico thirty years ago. People were using waters from the streams for irrigation purposes at that time. Of the prop-

erty which has been created since I came here more than one-half of it has been brought into use by irrigation. There is not now more than a million and a half acres under irrigation (1091).

" * * * I believe that fully fifteen million acres can be brought under irrigation by means of using the unused waters and by properly impounding and conserving the flood waters that we have. No part of this development or reclamation could be brought about under the doctrine of riparian rights. If that doctrine should be invoked and maintained, the progress of the Territory would be absolutely paralyzed so far as development in an agricultural way is concerned. The fifteen million acres which can be reclaimed would, when reclaimed, be worth from $20 to $50 an acre. It is worth now about ten cents an acre, a great deal of it, some of it from $1 to $1.25. This land when reclaimed would support, in my judgment, from two to three millions of people directly " (1092).

R. E. Twitchell (1097):

Have lived in New Mexico since 1882. Attorney at law. Connected with the Horticultural Society of New Mexico ever since its inception (1097). The assessed valuation of New Mexico is forty millions. Practically all of the property which is assessed in New Mexico is dependent upon taking the waters of the streams and applying them to the lands for irrigation purposes. Am the owner of a ranch and am engaged in irrigation to some extent. Forty acres of irrigated land would support a family.

The future of the Territory depends upon the continuous application of the waters of the streams to the arid lands. The property created by irrigation could not have been created if the doctrine of riparian rights had prevailed. Should the doctrine of riparian rights prevail in New Mexico, the reclamation act would have no force or effect here; it would not do us any good (1098).

Cross-examination (1100):

There are remains of ditches in San Juan County which are prehistoric.

Pedro Perea, ex-Delegate from New Mexico (1105):

Irrigation has been practiced along the Rio Grande in New Mexico for 300 years.

Wendell M. Reid. Direct examination (1113, 1114):

There are now between fourteen and fifteen thousand acres of land cultivated by means of reservoirs in Eddy County in the Pecos Valley, New Mexico. The lands are worth from $30 to $75 or $80 an acre on an average. There are fifteen thousand acres of irrigated land in Chaves County. They were worth about a dollar and a quarter an acre before they were reclaimed. Some of them have since sold for $400 an acre. On a general average I should say they would average about one to two hundred dollars an acre. The acreage here can be increased to 75,000 (1114).

I believe every forty acres in the Pecos Valley will support a family of five (1114). The country would simply return to the condition it was in before irrigation was undertaken if we were compelled to allow the waters flow in these streams as they did before, and the present population would either have to move or die. Lands close to a stream are frequently not good lands, and if irrigation was confined to the first or second forty acre tracts bordering on the stream it would reduce the irrigated area to a very small per cent of

what it is now. If we are permitted only to apply water from Government reservoirs to the first and second forty acre tracts away from the stream, the effect would be to completely ruin most of the projects under the reclamation act (1115).

J. W. Poe (1121):

Reside at Roswell, New Mexico. President of the Citizens' National Bank. Live in Roswell, the county seat of Chaves County, and have lived in this vicinity since 1881. When I came here there was from 150 to 200 acres of land under irrigation in Chaves County. There is now from eighteen to twenty thousand acres under irrigation. The land, before it was irrigated, was probably worth $1.25 an acre. It is worth now $40 an acre and upwards. Some would be worth several hundred dollars an acre.

When I first came here there were no trees, except a scrubby growth (1121). At the present time there are many thousands of trees in and around Roswell, independent of fruit trees. There are about 3,500 acres of fruit trees within a radius of fifteen miles of Roswell. Think tree growth has been produced by irrigation. Could not have amounted to anything without irrigation. The effect of tree growth upon climatic conditions is that it tends to neutralize to some extent the effect of the dry atmosphere and affords protection from the winds. Also has the effect to benefit health conditions. Sixty to seventy-five per cent of the valuation of this county has been created by and depends upon irrigation. The assessed valuation is about three millions. Think about 75,000 to 100,000 can yet be reclaimed from the arid condition in this vicinity. When I first came to Roswell there were about twenty-five people here, and probably 150 in the vicinity and for many miles. We now have 6,000. This population depends mainly upon the irrigation of land. The railroad which is here would not have come had it not been for the irrigation. There were no banks when I came here. We have three banks now, and at the last report to the Comptroller of the Currency they had a deposit of about $725,000 (1122, 1123).

Cross-examination (1123–1124):

My native State is Kentucky.

I know something about the conditions concerning agriculture there. In a general way, I should say that an acre of land here properly irrigated would produce nearly, if not quite, as much as three times what an acre would produce in Kentucky where I was born and raised—twice to three times as much, and in value more than that. The production of the land here can be greatly increased by what is known as "intensive farming." Under favorable conditions twenty acres will support a family of five. I believe it would be possible to support a family of five on ten acres here, with the improved methods of farming and horticulture.

S. Atkinson. Direct examination (1124):

Reside in Roswell, New Mexico. I am claim adjuster and land-tax agent for the Pecos Valley and Northeastern, or the Pecos lines. I am also in the abstract and land business. I have lived in Roswell since 1898. Formerly lived in Eddy.

The assessed valuation for Chaves County for 1904, in which Roswell is situated, was $3,004,822. The railroad from Roswell to the State line is exempt from taxation under the law of New Mexico,

as it has not been built six years. The assessed valuation of the property represents about thirty-five per cent of the real valuation. There are twelve millions of property in Chaves County. Seventy-five per cent of this property is dependent directly and indirectly upon irrigation. Ninety-five per cent of the population in this county is dependent upon irrigated lands. Practically the same conditions exist in Eddy County, immediately below Chaves County, on the Pecos River. We would not have much use for a railroad here if we did not have irrigated lands (1124). The railroad was induced to come here entirely by reason of the irrigation development and possible irrigation of the lands (1125).

William G. Hamilton. Direct examination (1125):

There are some twelve to fourteen thousand acres of land, I think, under cultivation in Eddy County by irrigation. The water is taken from the Pecos River to irrigate this land. In Chaves County there is approximately from seventeen to twenty thousand acres irrigated (1125). The lands in neither of these counties could produce crops from one year to another without applying the waters of the streams to irrigate them. If you should deprive these lands of the water which they now have, they would be worth not to exceed $1 an acre. It is estimated that approximately 100,000 acres in addition could be irrigated and put under cultivation in Chaves and Eddy counties with the waters that are at the disposal of the people here, and by reservoirs or by impounding them in reservoirs. The majority of that land is practically worthless except for grazing purposes. Were it irrigated, it would be worth forty to fifty dollars an acre on an average. For this one hundred thousand acres reclaimed the population would easily be increased one thousand per cent. There are in the neighborhood of twenty-five hundred acres of land in orchards here. A five-year-old apple orchard is worth $500 an acre.

The practice is to take the water just as far as the contour of the land will permit. If we were confined to lands bordering on the stream, say forty to eighty acres back, it would absolutely destroy our system of agriculture (1125, 1126).

Cross-examination by counsel for Colorado (1127):

Have had twenty-one years experience in irrigation (1127). It would have been impossible to create or maintain any irrigation enterprises in any place I have ever been under the doctrine of riparian rights, for the reason that nearly all of the western streams—the streams in the arid country where it is necessary to irrigate—are subject to flood rises and the land immediately adjoining the stream is almost everywhere submerged once or twice every year and sometimes more, according to the rainfall and snowfall and their locality. The lands nearest the river are not susceptible of irrigation, because they have been cut so much by floods at different times for centuries that the lands along the immediate banks of the river are never smooth enough to irrigate without such an enormous expense that it would have put off any work of that sort for another century, and for these reasons it would be necessary to carry these ditches back onto the higher lands, even if you were only to irrigate the lands riparian to the river, because it is necessary to get above the land in order to get the gravity flow to cover them.

I know of one tract of three acres of land here that has supported a family for the last year or two. It produced a net return of six hundred dollars an acre (1129).

Francis G. Tracy. Direct examination (1133):

Have been engaged in the Pecos Valley since 1890. When I first came to Eddy County there was no railroad. We have now a railroad from Pecos City through Carlsbad to Roswell and Amarillo. It starts in Pecos, Texas, and runs to Amarillo. Its length is four hundred miles. The area in cultivation when I first came to Eddy County was very slight indeed. There was not much irrigation from the Pecos River. There is now from twenty-five to thirty thousand acres under irrigation. Of these about fifteen thousand acres are in actual crops (1133). By using the unused waters of the Pecos River and reservoiring the flood waters possibly sixty-five or seventy-five thousand acres of land could be irrigated. Of this between twenty-five thousand and thirty thousand acres is Government land. It would not bring the Government price of $1.25 before it is reclaimed. The reclaimed land in Eddy County is worth about $50 an acre. If the lands were to be reclaimed, they would be worth as much as those already reclaimed and would support ten times the population of Eddy County as it is to-day. The population is about five thousand.

I have some idea what constitutes the doctrine of riparian rights. If that doctrine had been enforced on the Pecos River, the lands in Eddy County could not have been reclaimed. We carry the water some thirty miles from our reservoir, and our works are constructed forty miles, and back from the river nearly six miles.

If the irrigated area in Eddy County were to be limited to the lands riparian to the river—that is to say, the first or second forty acres from the river—it would be practically impossible to make any development owing to the high banks of the river and the difficulty and expense in getting the water up. Fully eighty per cent of the property in Eddy County has been created and exists by virtue of the taking of the waters out of the river and applying them to the lands for irrigation purposes. The railroad was built entirely because of these irrigation possibilities. There was nothing in either of these counties to induce the railroad to come in aside from the development that could be made by irrigation (1134).

Redirect examination (1137):

The assessed valuation for 1904 is about one million eight hundred thousand dollars for Eddy County, which is about one-third of the real valuation.

B. M. Hall, Supervising Engineer for the Territory of New Mexico and the Rio Grande Basin in adjacent States in the Reclamation Service of the Geological Survey. Direct examination (1139):

The reclamation act could not be carried out in any way if the doctrine of riparian rights prevailed in New Mexico. I have had that doctrine to contend with for twenty-five years.

If the irrigated area were confined to the first and second forties adjoining the stream, the provisions of the reclamation act could not be carried out.

J. J. Hagerman, of Roswell, New Mexico. Direct examination (1147):

Graduate of Ann Arbor in the class of 1861. Formerly president of the Pecos Irrigation and Improvement Company. This com-

pany spent $1,500,000 in irrigation enterprises in Eddy County. The plant, put in perfect condition or in reasonably good condition, would irrigate between forty and fifty thousand acres. The company also operated in Chaves County. The canals, dams, and other improvements cost two hundred and fifty thousand dollars.

For about nine years I was also president of the Roswell Land and Water Company. Since my connection with these different companies I have given a great deal of attention and study to the irrigation possibilities of the Pecos Valley (1148). Forty-five thousand to fifty thousand acres can be added to the irrigated area in addition to the land now irrigated in Chaves and Eddy counties by the use of the unused waters of the Pecos River and its tributaries and by the application of those waters and by impounding the flood waters. If the irrigation possibilities were developed it would add one hundred thousand people.

Lands in the Pecos Valley before they were irrigated were not worth the Government price of $1.25 an acre. Have given thought and study to the doctrine of riparian rights. It would have been impossible to have made the development which has already been made in Chaves and Eddy counties under the application of that doctrine. Its application would stop future development in this valley.

If we were confined to the first and second forty-acre tracts riparian to the river, it would be almost impossible to irrigate any lands in this valley. There was no railroad in the valley when I came here. In the year 1899 I raised the money in the East to build the road from Pecos City to Carlsbad, and that was finished in 1890; that was ninety miles. In 1893 I raised the money to build the road from Carlsbad to Roswell, seventy-five miles, and in 1897 I raised the money in the East to build the road from Roswell to Amarillo, Texas, a distance of 220 miles, I believe. I was president of the companies that built these roads. They would not have been built had it not been for the known irrigation possibilities (1149).

Believe that eighty per cent of the property which now exists in Chaves County so exists by reason of the taking of the water from the streams and applying it to the lands for irrigation purposes (1149, 1150).

Have made a study of the so-called reclamation act. There would be no excuse for the existence of that act if the doctrine of riparian rights were applied.

To confine the irrigated area to lands bordering on the stream and within half a mile of it, its effect would be utterly destructive of the administration of the reclamation act, because there could hardly be any irrigation of that kind.

Have made a study of the effect of irrigation upon forestry. It is impossible to develop forestry in the arid region without irrigation, except in a few scattering small places. The effect of forestry upon atmospheric and climatic conditions in the arid region is very beneficial. One of the greatest drawbacks to the development of the arid region is the high winds. The more trees there are planted the more ground there is covered with vegetation, and of course the greater the rainfall, and that which does fall is conserved and moistens the atmosphere and moistens the air and serves as a barrier

to the winds and makes a country which otherwise would be almost uninhabitable just as good as any other country (1150).

Generally speaking, I think we get in Chaves County certainly two and a half and three times as much per acre per annum as they get in Michigan and Wisconsin. I know of good farmers in the Hagerman district especially who make a good living and prosper, with a family of five, on forty acres of land. I know a man who received $3,000 for the apple crop off twelve acres two years ago. I think a family of five could make a good living off forty acres in this valley. It is the tendency of development by irrigation to reduce the holdings to a small acreage of land.

With intense farming a tract less than forty acres is sufficient to support a family of five. As time goes on the tendency in irrigated districts is to make small farms and a dense population (1155).

Redirect examination (1155):

The same natural conditions which prevail in New Mexico prevail in the arid region of the United States generally, which extends from the 98th or 99th meridian almost to the Pacific coast.

I am president of the company that owns a large apple orchard in the Pecos Valley of about five hundred acres, and there are 50,000 trees. It has been developed by irrigation processes entirely. This country is peculiarly adapted to the raising of apple trees.

B. S. Rodey, Delegate to Congress from New Mexico (1156):

Believe between ten and fifteen million acres can be irrigated in New Mexico. One-half of this area is now Government land. In its present condition it would be worth about fifty cents an acre. When irrigated, would be worth from fifty to three hundred dollars an acre. When irrigated would support two or three million people.

If the people of the Territory were compelled to permit the waters of the streams to run undiminished and unaffected, it would stagnate the Territory. If the old common-law doctrine of riparian rights, that water must go by undiminished and undeteriorated in quality, should prevail in New Mexico and the semi-arid Southwest, it would render the streams useless and the land along them absolutely useless. If the irrigated area were confined to lands lying near or adjacent to the stream—say the first or second forty—it would render future development small. It would consist only of little ribbons of land near the streams. It would practically stagnate development. This partial irrigation would also thwart the main purpose of the so-called reclamation act. In accordance with the spirit with which it was enacted I believe that act will accomplish the full reclamation of the west. Irrigation has been practiced in New Mexico from time immemorial (1156, 1157).

Fred T. Dubois, Senator from Idaho (1190):

The assessed valuation of Idaho, outside of improvements, in 1904 was twenty-six or twenty-six and one-half millions. Two-thirds of that was produced by irrigation. About a million acres of land have been reclaimed in Idaho. Three-fourths, if not nine-tenths, has been reclaimed since I went to Idaho twenty-five years ago. The land was worth nothing before it was reclaimed. It now runs from $25 an acre to $1,000 an acre. To name $40 as an average price would be putting it pretty low. Not all the lands which can be irrigated have been reclaimed. We are just starting in. By using the unused waters and impounding and storing the flood waters we

could add four and a half million acres to what we have. That land is not worth anything now. When irrigated and intensely farmed, I would say they would be worth $40 an acre on the average (1190, 1191).

I lived in Illinois before going to Idaho. The land in Idaho is much richer than that in Illinois. It raises more per acre in quantity and quality. The same amount of land in Idaho would support a denser population than in Illinois.

If we were not allowed to use the waters in the streams except by reasonable use for manufacturing and domestic purposes, the land already reclaimed could not have been reclaimed and there could not be any future development in Idaho. We are dependent absolutely on irrigation.

If the irrigated area in Idaho should be confined to the lands bordering upon or adjacent to the streams within three-quarters of a mile thereof, it would be almost as detrimental as a total denial of the use of the water. In respect to the lands already irrigated, there are not a thousand acres of land within three-quarters of a mile of the stream from which they are irrigated (1191).

I am familiar with the so-called Carey Act. I was chairman of the committee at the time it was passed, I think. The State of Idaho accepted the provisions of that act very quickly. About four millions has been expended under its provisions. Four or five hundred thousand acres have been taken up under that act.

The doctrine of riparian rights would destroy the effectiveness of the Carey Act.

I was Senator from Idaho when the reclamation act was passed. Was a member of the committee of seventeen, and presided over a number of the meetings. The enforcement of the doctrine of riparian rights would reduce the amount of money which could be put into reclamation by at least two-thirds. It would stop the taking of any land in south Idaho.

There is a necessity for the cultivation of forestry in Idaho. I don't think it could be successfully cultivated there without irrigation. I think it would be impossible, that is, in south Idaho (1192).

Cross-examination by counsel for Colorado (1195):

It takes much less number of acres of land to support a family in Idaho than in most of the agricultural States.

Joseph M. Dixon, member of Congress from Montana (1196, 1197):

The number of acres of irrigated lands in Wyoming when I first went there, was 951,154. It is considerably in excess of a million acres now. The assessed valuation for the State of Montana in 1902 was $86,451,577. Over one-half of the assessed valuation is based upon irrigation. The figures that I have given you do not include personal property nor do they include the railroads and mines. I am told by engineers that it would be possible to irrigate eight million acres of land in addition in the State. I think the judgment of the engineers is correct. The irrigated lands in Montana are worth $35 an acre. Without irrigation, about a dollar and a quarter an acre. I think if these eight million acres were reclaimed it would support a million people directly or indirectly. We add to the development every year. The population is increasing every year in direct ratio to the amount of irrigation. The population of Montana has trebled since I went there.

There could have been no development along these lines except a very narrow margin immediately along the banks of the stream under the old doctrine of riparian rights. The effect of such a doctrine would be to absolutely prohibit any further development along irrigation lines. If the irrigated area were confined to the lands within one-half or three-quarters of a mile from the banks of the stream, it would put a complete stop to further development. Should the strict riparian doctrine be enforced it would destroy three-quarters of the farming lands of the State (1197). It would reduce the present population of the State one-half, in my judgment. The enforcement of the doctrine of riparian rights would nullify the operation of the reclamation act.

The provisions of the reclamation act would be nullified should it be established that the irrigated area must be confined to within half to three-quarters of a mile of the banks of the stream.

Fifty per cent of the present development depends upon irrigation, and practically all of the future development depends upon irrigation. Our average per acre of grain crops is about double on the irrigated lands of the west as compared with the farming lands in the Mississippi Valley. I have had occasion to take this matter up and investigate it. There are four or five Indian reservations in Montana, and the Indians thereon are dependent upon the irrigation of land for their support and upon stock raising. If the Indians were forbidden to use the waters of the streams for irrigation upon these reservations, they could not develop crops. There is necessity for the cultivation of forestry in a portion of the State where timber does not exist, on the eastern slope, from the crest of the Rocky Mountains to the Dakota line. Forestry can not be successfully cultivated without the aid of irrigation (1198).

Henry C. Hansbrough, United States Senator from North Dakota, chairman of the Committee on Public Lands in the Senate (1206):

Was a member of the committee of seventeen which framed originally and reported the bill which became the reclamation act of 1902 (1206). From eight to ten million acres of land could be irrigated by damming in North Dakota—that is, by damming the Missouri River, as well as the Yellowstone, and using the flood waters of those streams and their tributaries. The land is not now worth a dollar an acre in the arid section. By a complete system of irrigation that land would be worth from $30 to $50 an acre. This additional land would support a vast population. Less than half a section would support a family of five.

If it should be declared that the streams should be allowed to flow undiminished in quantity and unaffected in quality, the effect would be that there would be very slight development. The future development of the arid regions of North Dakota depends entirely upon the taking of the streams for irrigation purposes and upon the impounding of the flood and other waters for such purposes. Should it be declared that the irrigated lands be confined to those bordering on the stream or within one-half or three-quarters of a mile therefrom, the effect would be that along the Missouri River where there are what are known as table-lands a considerable amount of that land could be irrigated by dams not very difficult to construct, but to get it out on the higher lands you would have to have an enormous dam. I do not think, however, that one-tenth as much land could be

reclaimed as can be reclaimed if you are allowed to take water far from the river and from the banks of the river (1207).

I believe that the future development of the arid region in this country depends upon the passage of some such act as that and the adoption of a policy of national reclamation. I do not think that the reclamation act could be effectively enforced and administered if the irrigated area should be confined to the lands riparian to the stream. From the information which the committee of seventeen had in respect to the number of acres which can be reclaimed under the operation of the act, it is not far from a hundred million acres (1208).

Cross-examination (1209):

The Missouri River is a navigable stream in North Dakota, but the irrigation interests are paramount to those of navigation (1209).

I think it would be the wisest thing that I can imagine for the Government to purchase all the steamboats and prohibit the further construction of steamboats on that part of the Missouri and devote the stream entirely to irrigation. I would not destroy navigation on any stream where the interests of the community are largely dependent upon water for transportation (1210).

Cross-examination by counsel for Colorado (1213):

In my judgment the navigation at Bismarck would be of very small consequence in comparison with the advantages of irrigation. We have not had much irrigation under the National Government up to this time in North Dakota.

Alexander Oswald Brodie, ex-Governor of Arizona. Direct examination (1259):

Resided in Arizona 20 years. When I went there there was from six to nine thousand population; at the present time there is 170,000. The present assessed valuation is forty-five millions.

Arizona is in the arid belt. When I went there there was not over ten thousand acres under irrigation. At the present time there is in the neighborhood of 350,000 acres under irrigation.

Before irrigation, $1.25 would be a fair price for the land. Its average price now is from $30 to $50 an acre. Have heard the statement made that on the Arizona side of the Colorado River there can be reclaimed by the waters of that stream three hundred thousand acres. There is another reservoir project for the storage of flood waters that will add fifty thousand acres to the irrigated area, and another one that would add fifty thousand more. There are several ten and twenty thousand acres projects (1259). The land to be reclaimed has no value. Nearly all of this land which can be reclaimed is Government land. Twenty acres of irrigated lands in Arizona would support an average family of five (1260).

Cross-examination by counsel for Colorado (1262):

Among other crops we raise dates, oranges, peaches, apricots, apples do well, pears, plums, and other fruits. An orange orchard with trees five or six years old would be worth perhaps $500 to $800 with water rights. The other fruit lands would be worth from $100 to $150 an acre.

Redirect examination (1263):

Originally came from New York. Thirty to fifty per cent of the population in Arizona depends upon the irrigation of lands. Irrigated lands will produce more per acre and support a denser popu-

lation than lands in the humid belt depending on rainfall altogether. In the near future irrigation will tend to reduce the holdings of land. It has done so in the past. The reason for this is that it takes so much capital to irrigate, especially in our Territory.

Joseph L. B. Alexander (1264):

Reside at Phoenix and have resided there for 21 years. Arizona has been mostly developed through irrigation. The future development along agricultural lines is dependent entirely upon taking the waters out of the streams and applying them to the lands for irrigation. Should the irrigated area be confined to within three-fourths of a mile of a stream, the present development would be destroyed and the future development would be prevented.

W. H. Code. Direct examination (1315):

I am inspector of irrigation under the Department of the Interior for the Indian reservations throughout the West. Have charge of forty-seven Indian reservations in North and South Dakota, Montana, Washington, California, Idaho, New Mexico, Oregon, Nevada, Wyoming, Colorado, Utah, and California (1315). All these reservations are located in the arid region. It is necessary for the purpose of cultivating and producing crops on them that we have irrigation, with the exception of a few reservations in western Oregon and Washington and one or two in northern California.

There are 48,000,000 acres, approximately, of unallotted lands on these reservations and approximately three and a quarter million acres of allotted lands. There are about one hundred and sixteen thousand Indians located upon these various reservations. Approximately 200,000 acres are covered by canals on these reservations. By using the unappropriated waters of the different streams from which we now take the waters for irrigation on these reservations a million and a half acres could be added. It is necessary for the support of these Indians upon the reservations that the lands thereon should be cultivated. It seems to me to be their only hope for independence. The reservations can not be made to support the different tribes unless irrigation is practiced (1316). In my judgment, unqualifiedly, the future development is dependent on irrigation to a large extent. If the irrigated area should be confined to the lands bordering on the stream, say for half or three-quarters of a mile from its banks, the effect would be to put a stop to all development, and such as has been made would go back to the desert, as I understand it. As to the effect upon the present development in the Indian reservations, I would say that they would suffer very materially if irrigation should be confined to the lands immediately bordering on the streams. The irrigated sections on the Indian reservations are considerable distances from the streams. The best lands are back from the streams—one-half to five miles back (1317).

Cross-examination by counsel for Kansas (1317):

The Pima Reservation, on Gila River, in Arizona, is one of the 47 reservations I am superintendent of for irrigation purposes. The Pima Indians have suffered at times for water for irrigation. The shortage of water was due in part to the taking of the same from the Gila River above the reservation (1317).

Am acquainted with the Milk River and know something of the controversy existing between the United States and the Canadian government over the appropriation of its waters. Milk River flows

from Montana into Canada, and then from Canada into Montana, and then into the Missouri River. The waters were first appropriated by settlers in Montana below the line where it crosses from Canada into Montana. In the States and Territories I am familiar with lands along the stream prior to irrigation had no practical value and were practically unproductive down to the banks of the river (1318, 1319).

Cross-examination by counsel for Colorado (1319):

The longer the lands are irrigated the less water is needed for irrigation. There are prehistoric evidences of irrigation in Arizona (1319). Ancient irrigation ditches can be seen, and in their construction they show evidence of a great deal of skill.

It is the policy of the Indian Bureau to give the Indian water for his land subsequently to the allotment and throw him upon his own resources and endeavor to make a citizen of him, and the result of this policy has been quite encouraging up to date (1320). From the testimony of many of the early settlers I know that the grazing off of the grass upon the headwaters of the streams in Arizona has changed conditions materially in the northern part of that Territory. Prior to 1892 the watersheds of the streams were covered with bunch grass ranging in height from two to six inches. This grass would hold the rain back when it fell and there would be no erosion. Since this grass has been eaten off the lands in the watersheds of the streams are hard packed and all vegetation is gone. Heavy rains falling on it cause great erosion. The run-off is rapid, and the effect has been to decrease the usual flow of the streams (1321).

Irrigated lands in the west are more productive than nonirrigated lands in the humid regions of the east. In Arizona a family of five can live very nicely on twenty acres of land, provided they have sufficient water supply. Twenty acres of land in Arizona would be equivalent to 60 or 80 acres in the Eastern States. The greater diversity of crops can be raised on irrigated lands than on nonirrigated lands. The tendency in the irrigated section is to reduce the size of the holdings of land (1322).

Redirect examination (1323):

Grazing upon the headwaters of streams has had the same effect upon the entire arid region in the west as that to which I have testified in Arizona, and in Arizona they feel the effects of this worse than in some States and Territories. About $1,500,000 has already been expended in the construction of ditches upon the Indian reservations under the supervision of the Government (1323). The Government started out on the policy of irrigating the Indian reservations seven or eight years ago. Assuming that there are 2,000,000 acres that could be irrigated in all the Indian reservations in the west, it would cost in the neighborhood of from twelve to fifteen million dollars.

(18) EVIDENCE IN RESPECT TO THE EFFECT ON THE PRESENT AND FUTURE DEVELOPMENT OF THE ARID REGION SHOULD THE DOCTRINE OF STATE OWNERSHIP OF THE WATERS AND STREAMS RISING IN SUCH STATE PREVAIL.

Clarence T. Johnston (1022, 1024):

The following streams rise in Colorado and flow into Wyoming: The Laramie, North Platte, Sand Creek, and the Snake, a tributary

to the Green River. Citizens of Colorado are taking the waters from those streams in that State and using them to the injury of prior appropriators in Wyoming (1024). If all the waters in these streams should be appropriated and used in Colorado, it would ruin the development already made along these streams in Wyoming and prevent any future development (1026).

Nellis E. Corthell (1035) testified to the same effect as Mr. Johnston.

He further testified (1036) that citizens of Colorado were taking water out of Sand Creek by a ditch known as "Divide ditch" to the injury of appropriators below in Wyoming, and carrying the water so appropriated over a divide and into the watershed of Sheep Creek, thus preventing the return of seepage waters to Sand Creek. He illustrated by referring to Intervenor's Exhibit 1, which shows Sand Creek, Sheep Creek, and the Divide ditch.

S. C. Downing (1045), secretary of the Wyoming Central Land and Improvement Company, also of the Pioneer Canal Company, which operates in Wyoming:

There are about 20,000 acres under the canals of these two companies. They take the water from the Big Laramie River in Wyoming. There have been appropriations of water from the Laramie in Colorado subsequently to that made by the two companies named. If the ditches which are now being built in Colorado to take water out of this river are completed it would result in making the 20,000 acres referred to in Wyoming of no value. They are now worth about $75 an acre.

In addition to the lands owned by the two companies there would be 200,000 acres of land along the Laramie River in Wyoming which would be injuriously affected if the appropriations now contemplated from the Laramie River in Colorado are completed."

Gibson Clark, of Cheyenne, Wyoming (1047, 1049):

Attorney for the Wyoming Development Company. Its property is situated about 100 miles north of Cheyenne. The railroad station is Wheatland. There are about 65,000 acres under the irrigation system and about 22,000 acres under actual cultivation.

The water is taken from the Laramie River, which heads in Colorado (1049). The appropriation in Wyoming dates back to the 16th of May, 1883. Subsequent appropriations from the same stream have been made in Colorado. Should the citizens of Colorado under these subsequent appropriations persist in taking all the water in the stream in Colorado it would be destructive of the property rights of the Wyoming Development Company in Wyoming. This company has invested about $750,000 in cash, and has had no returns during the last 20 years. There are about 200,000 acres of land irrigated from the waters of the Laramie River in Wyoming which would become absolutely arid and incapable of supporting anything if the water was now taken out of the river in Colorado (1050).

M. R. Johnston, superintendent Wyoming Development Company (1059):

If the waters of the Big Laramie were to be appropriated and diverted and used in Colorado, the effect would be ruinous to our enterprise.

Joseph M. Carey, ex-Senator from Wyoming (1324, 1327):

I am president of the Wyoming Development Company. It was organized in the 80's. It operates in Wyoming. We contemplate the irrigation of about 75,000 acres. The company irrigates about 50,000 acres. It has made an appropriation of water for 75,000 acres. If the waters of the Laramie River were now to be taken by persons on the Colorado side for irrigation purposes, the investments in these companies would be destroyed (1327). The constitution of Wyoming in respect to water contains a provision similar to that of Colorado. Have never heard any citizen in Wyoming claim that its citizens had the right to take waters from streams which have their source in that State to the injury of prior appropriators in the State below (1328).

Walter B. Dunton, employed by the Irrigation Investigation Division of the Agricultural Department (1070):

There are appropriations in Colorado from the Laramie River subsequent to the appropriations made in Wyoming, which would probably take 75 per cent of the water before it reaches the State line. If these subsequent appropriators in Colorado should be permitted to take the water, it would very seriously injure land now irrigated in Wyoming by prior appropriation.

Miguel A. Otero, Governor of New Mexico (1076, 1077):

There are appropriations from the Rio Grande in New Mexico two or three hundred years old. Recent appropriations from the stream in Colorado have affected the appropriations in New Mexico below the State line (1077).

Luther Foster, President Agricultural College of New Mexico (1079–1081):

Appropriating and using the water in San Luis Valley in Colorado has made the water short in the river in New Mexico (1081). If Colorado should take and use all the waters of the streams which rise in that State and flow into New Mexico, it would largely injure our agricultural interests along those rivers (1082).

Thomas B. Catron, of Santa Fe, ex-Delegate from New Mexico (1092):

Appropriations along the Rio Grande in New Mexico have been materially interfered with by appropriations in San Luis Valley, in Colorado, by diminishing the flow of the water in New Mexico. During the past ten years it has been impossible to increase the amount of irrigated lands along the Rio Grande in New Mexico.

R. E. Twitchell, of Santa Fe, New Mexico (1097, 1099):

The flow of the Rio Grande in the southern half of New Mexico has been diminished very much in recent years. Attribute this decrease to the deforestation of the lands along the river in the counties above.

Pedro Perea, of Santa Fe, ex-Delegate in Congress from New Mexico (1105):

Have lived on the Rio Grande all my life in New Mexico. My father lived there before me. Irrigation has been practiced on the Rio Grande for two or three hundred years, I suppose. There has been a very material decrease in the waters in the river in the last 20 or 25 years (1105). I think the use of the water in Colorado is the cause of this decrease (1106).

Solomon Luna, of Los Lunas, New Mexico (1109):

Born in Los Lunas, which is on the Rio Grande. My father was born there. The irrigated lands in my county, Valencia, have decreased in recent years about one-third. The decrease began in 1872. It was 1879 or 1880 that the river first went dry, to my knowledge. I know they irrigate lands from the river in Colorado on an extensive scale. The stream began to diminish when they began to take water out in Colorado. It has continued to decrease ever since. I should judge the percentage of decrease in the irrigated lands in the two counties—of lands south of where I live in New Mexico—is about forty per cent.

George H. Maxwell (1163–1167):

If the State which is the source of an interstate stream should take all the waters of that stream, it would have the effect of destroying the irrigation industries along the stream in the lower State and would destroy all the agricultural development depending upon irrigation in that State (1167). Such a course would also, in my judgment, render the national irrigation act practically inoperative (1168).

Frank W. Mondell (1179–1182):

Property which depends upon prior appropriation of waters from an interstate stream in Wyoming would be greatly injured or entirely destroyed if the citizens of Colorado, the source of those streams, should now take all the waters therefrom and apply them to land in that State for irrigation purposes.

F. H. Newell (1265–1273):

There are difficulties before the reclamation service between the different States and between the State governments and this Government. In the case of the Rio Grande in New Mexico there are international difficulties with Mexico, and on the northern boundaries there are difficulties with Canada. Canada has already given to a company the water of Milk River, and that company is proposing to take it out to the detriment of present settlers in the Milk River Valley in northern Montana, who are prior appropriators (1273). Should the self-interest of an upper State alone, in which there is an interstate stream, be such as to enable it to take all the waters of the stream, and a difficulty with the lower State could not be settled amicably, we would simply wait until this suit is decided to settle principles upon which future projects under the reclamation act along interstate streams may be considered. If the State in which an interstate stream rises should persist in taking all the water before it reaches the State line, this would, of necessity, destroy the irrigation possibilities in the lower State so far as those are dependent upon the waters of the river that come from the upper State.

"We, in the administration of the reclamation service, have tried to avoid the difficulties and are vitally interested in securing the establishment of a principle on which we can take up these questions in the future. If it should be established that the upper State should have the right to take all of the water of an interstate stream that falls within her borders, it would necessitate a readjustment of many of these projects and in some cases an abandonment of lands which, as to low altitude, are perhaps a little better situated climatically, and it would practically contract the application of the reclamation act to those upper States so far as the physical possibilities extend."

Francis E. Warren, Senator from Wyoming (1289–1291):

The reclamation act, in order to be successful, must jealously guard the right of priority in the use of water, regardless of State lines, and that priority must rest upon the continual use for irrigation.

Elwood Mead (1363–1419):

"As to whether the establishment of the State-line doctrine will work the least injury to the country at large, I will say that depends entirely upon the locality. There are places where the establishment of the State-line doctrine would undoubtedly greatly simplify irrigation development and work the least injury; on the other hand, there are cases where the refusal to establish that doctrine would work such an injustice that I am sure it would never be permitted. But there is no question that both Wyoming and Colorado would be immensely benefited by the establishment of absolute State sovereignty. There is no doubt that a great many problems of irrigation would be simplified by such a doctrine, but these two States are preeminently in a favorable position for the application of that doctrine; that is, as applied to water."

Intervenor's Exhibit No. 17.

[U. S. Department of Agriculture, Weather Bureau. Station, Dodge City; County, Ford; State, Kansas. Latitude, ——; longitude, ——; elevation, —— feet.]

Data; precipitation 1874–1904, inclusive.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.	Excess.	Deficiency.
1874										0.27	0.24	0.05			
1875	0.12	0.10	0.04	0.71	2.26	0.73	3.28	2.06	1.32	0.06	T.	0.09	10.77		9.07
1876	T.	0.05	3.59	0.16	1.15	2.53	2.26	1.03	2.13	1.00	1.35	0.15	15.40		4.44
1877	0.18	0.56	0.25	3.38	4.96	3.92	1.79	4.09	0.50	3.34	0.56	4.36	27.89	8.05	
1878	0.21	1.13	1.01	1.06	4.63	2.19	1.61	4.48	0.76	0.09	0.60	0.19	17.96		1.88
1879	0.87	0.08	0.17	0.40	0.90	4.40	3.90	3.75	0.80	T.	0.04	0.12	15.43		4.41
1880	T.	T.	0.04	0.11	3.33	1.59	4.00	5.17	0.32	1.42	2.43	0.03	18.44		1.40
1881	0.15	1.63	0.50	2.38	12.82	1.77	5.06	2.36	3.13	2.19	0.95	0.61	33.55	13.71	
1882	0.52	0.22	0.24	0.68	3.87	1.51	3.04	1.07	0.15	1.62	0.11	0.11	13.14		6.70
1883	0.44	1.42	0.42	2.40	5.41	4.31	2.61	5.66	1.32	3.32	0.12	1.07	28.50	8.66	
1884	0.08	0.28	1.91	1.07	4.47	7.67	6.40	4.82	0.23	1.50	0.83	1.10	30.36	10.82	
1885	0.52	0.47	0.75	1.39	4.07	2.02	6.03	1.80	3.48	1.06	0.36	1.76	23.71	3.87	
1886	1.82	0.46	1.50	1.90	0.40	5.47	2.07	2.46	2.33	0.45	0.24	0.25	19.35		0.49
1887	0.07	0.53	0.17	2.46	3.69	4.00	1.00	2.28	0.14	0.48	0.35	0.54	15.71		4.13
1888	0.23	0.73	0.93	4.08	2.86	5.16	4.07	3.00	0.78	0.81	0.06	0.23	22.94	3.10	
1889	1.69	0.34	1.38	2.12	1.54	3.43	2.02	2.14	0.86	2.88	0.77	0.00	19.17		0.67
1890	0.42	0.39	0.05	2.90	1.19	1.00	0.22	3.45	0.57	0.89	0.50	0.14	11.72		8.12
1891	0.98	0.27	3.32	2.76	3.36	6.27	5.16	1.36	4.56	3.33	0.12	0.85	32.34	12.50	
1892	0.25	1.01	2.62	0.40	3.23	3.34	0.66	4.69	1.04	0.73	0.31	1.38	19.66		0.18
1893	0.02	0.34	T.	0.04	1.31	0.76	3.32	1.82	1.74	0.25	0.42	0.10	10.12		9.72
1894	0.04	1.03	0.40	1.88	0.95	2.80	2.05	0.15	2.03	0.62	0.03	0.62	12.60		7.24
1895	0.58	2.26	1.31	0.91	0.97	5.32	4.84	2.42	0.06	1.09	0.34	0.21	20.31	0.47	
1896	0.49	T.	0.25	5.50	1.13	1.98	5.41	0.73	1.06	2.45	0.34	0.53	19.87	0.03	
1897	1.44	2.38	0.26	3.21	1.49	2.31	3.91	3.06	0.60	2.66	0.06	0.20	21.58	1.74	
1898	1.74	0.70	0.24	0.97	10.31	4.57	3.14	2.26	3.16	1.87	0.96	1.54	31.46	11.62	
1899	0.06	0.20	0.47	0.55	1.50	11.17	6.56	0.50	1.71	3.94	1.15	0.62	28.45	8.61	
1900	0.17	0.99	0.58	4.08	2.20	2.62	3.07	1.32	4.63	0.92	0.09	0.09	20.76	0.92	
1901	0.13	0.48	0.80	3.45	1.75	2.63	1.81	0.71	2.54	1.64	0.04	0.08	16.06		3.78
1902	0.34	0.16	1.58	0.76	3.35	2.49	3.73	1.62	0.60	2.26	0.53	0.28	17.70		2.14
1903	0.06	2.87	0.67	1.97	2.88	1.49	0.59	2.21	0.15	1.28	1.03	0.05	15.27		4.57
1904	0.08	0.02	0.04	1.54	4.42	2.02	1.71	3.99	1.82	0.87	0.04	1.19	17.19		2.65
Average	[a]0.46	0.70	0.85	1.84	3.21	3.38	3.18	2.55	1.48	1.44	0.48	0.60			

[a]Average for 30 years, January-September, inclusive. Average for 31 years, October-December, inclusive.

Normal yearly rainfall 19.84 inches.

I do hereby certify that the above is a true copy of the records on file in this office.

T. B. Jennings,
Section Director, Weather Bureau.

Topeka, Kans., *June 15, 1905.*

INTERVENOR'S EXHIBIT No. 18.

[U. S. Department of Agriculture, Weather Bureau. Station, Wichita; County, Sedgwick; State, Kansas. Latitude, ——; longitude, ——; elevation, —— feet.]

Data; precipitation 1888–1904, inclusive.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.	Excess.	Deficiency.
1888	.....	.....	.....	.....	.....	.....	1.04	7.77	1.89	1.36	1.29	0.71	.....	.....	.....
1889	0.82	0.57	2.41	5.18	3.88	7.89	4.72	3.79	2.10	2.14	1.14	0.03	34.67	5.01	.....
1890	2.12	0.35	0.14	3.63	2.17	5.05	0.95	2.60	1.96	2.39	1.72	1.04	24.11	.....	5.55
1891	2.66	1.95	3.36	1.26	9.15	4.90	5.59	0.40	0.72	2.95	0.47	1.12	34.53	4.8	.....
1892	0.31	2.62	4.03	2.06	5.83	1.70	2.75	4.06	2.12	2.52	0.24	1.71	29.94	0.2	.....
1893	0.19	0.80	1.09	0.25	2.22	3.41	5.02	1.51	2.10	0.02	0.91	0.67	18.19	.....	11.47
1894	0.78	1.01	0.72	3.33	2.02	9.43	1.72	0.94	9.72	2.01	0.01	0.75	32.44	2.78	.....
1895	0.57	1.19	1.81	0.40	2.77	4.47	2.74	7.67	0.86	0.81	1.80	1.37	26.46	.....	3.20
1896	0.62	0.37	1.58	3.26	3.02	7.10	3.40	0.31	3.08	2.27	1.42	0.63	27.06	.....	2.60
1897	1.23	1.31	3.34	3.66	2.48	1.99	1.49	4.33	1.22	3.89	0.10	0.97	26.01	.....	3.65
1898	1.97	3.04	0.95	5.16	8.32	5.24	5.30	2.78	1.55	2.02	1.13	2.00	39.46	9.80	.....
1899	0.38	0.20	2.53	1.58	5.72	6.81	4.62	2.45	4.75	1.55	1.09	1.81	32.49	2.83	.....
1900	0.10	2.10	0.83	2.77	6.50	3.41	2.16	1.69	5.64	5.71	0.21	0.73	31.85	2.19	.....
1901	0.25	1.29	1.52	5.83	1.40	3.16	3.44	2.00	8.04	3.86	1.16	0.52	27.47	.....	2.19
1902	0.32	0.75	2.79	0.87	10.33	7.11	4.12	5.28	2.69	2.02	1.76	0.69	38.73	9.07	.....
1903	0.08	1.71	1.61	3.31	7.97	1.26	1.46	4.46	2.25	5.96	0.75	0.26	31.08	1.42	.....
1904	0.12	0.04	4.23	2.65	5.74	5.69	7.46	1.42	3.10	0.35	0.07	0.24	31.11	1.45	.....
Average..	0.78	1.21	2.06	2.82	4.97	4.91	3.41	3.09	2.88	2.40	0.90	0.89	.....	.....	.....

Normal yearly rainfall, 29.66.

I do hereby certify that the above is a true copy of the records on file in this office.

T. B. JENNINGS,
Section Director, Weather Bureau.

TOPEKA, KANS., *June 15, 1905.*

(19) THE NAVIGABILITY OF THE ARKANSAS RIVER.

The complainant alleges (63) that the Arkansas River is a navigable stream under the laws and departmental rules and regulations of the United States. Further, that it is a large navigable stream, and is used for the purposes of trade and commerce from its mouth to Fort Gibson, Indian Territory (63–64), and that from its mouth to the Colorado line has always been treated as a navigable river (67).

Each of the defendants, in their answers, denies that the river is navigable in the State of Kansas. The intervenor, by its petition of intervention, concedes that the river is navigable from its mouth through Arkansas and in the Indian Territory, but denies that it is navigable in Kansas and Colorado (235).

M. M. Murdock, who has resided at Wichita since 1872, and since that time has been the editor of the Wichita Eagle, upon this point testified, on direct examination, in effect, as follows (260, 261):

That he and Senator Plumb and some others got up a scheme of running a man for Congress from Topeka upon the issue of the navigability of the Arkansas River; that freight rates were based upon navigable waters; that steamboats running up and down the river would give water rates for their wholesalers; that engineers were sent out from Washington and were told to keep in touch with him, and that one of these engineers assured him that a channel could be put through from Wichita to Arkansas City sufficient for

navigation with little boats; that one Walton built a flatboat at Arkansas City and started for Wichita and got within twelve miles thereof. This was in 1870. That in the early days a number of boats were built at Wichita to haul lumber down to Arkansas City. This was before there was any railroad between the two points. That little flatboats came down from Colorado; that there was some flour shipped down the river in flats. No boat ever got back that ever went down—they didn't go with that idea. The river was not navigable for any practical purposes after the commencement of irrigation in Colorado, and, in his judgment, was not practically navigable before that time. He stated that President Grant said at one time that the river would be navigable from Wichita to its mouth if it was copper lined. Witness adds: "I guess he was about right."

R. E. Lawrence, who has resided in or near the city of Wichita since May, 1870, said (333), on direct examination:

That there was a flatboat built at Wichita and loaded with wheat and taken down the river to New Orleans about 1880; that many boats were built at Wichita to go down the river for pleasure and fishing trips; that some Government boats were used for moving from place to place; and that a boat was started from Wichita with steam power.

On cross-examination by counsel for Colorado he stated that he would not say that the river at Wichita is commercially navigable; that he didn't think that it was ever practically navigable at Wichita; that it was dredged by the Government, but that no navigation took place thereafter; that only the dredging boat came up; that at the time they tried to make the river navigable there were no railroads through Wichita; and that before the Government got through with dredging it out the water was gone.

At this point counsel for complainant introduced the act of Congress of March 3, 1879 (20 Stat., 366), which provided for an appropriation of $20,000 for the improvement of the river between Fort Smith and Wichita (333); also act of June 14, 1880 (21 Stat., 187), which provided for an appropriation of $15,000 for the same purpose; also act of March 3, 1881 (21 Stat., 477), making an appropriation of $24,000 for the same purpose; also act of March 2, 1882 (22 Stat., 205), making an appropriation of $35,000 for improving the Arkansas River; also act of the legislature of Kansas of 1864 declaring the Kansas, the Republican, Smoky Hill, and the Solomon and Blue rivers to be not navigable, and authorizing the bridging of the same (334).

E. H. Franey, who had lived in Arkansas City since 1880, on direct examination, said (369):

That in 1880 he saw a boat coming down the river seven miles above Arkansas City. Didn't know where it came from. It continued down the river. It seemed to be loaded with something. There was another boat here called the *Aunt Sally.*

On cross-examination by counsel for the intervenor, witness said, in effect:

That he never saw the *Aunt Sally;* it was loaded at Arkansas City, at the mouth of the Walnut, and went down the stream, but to his knowledge never came back; that there are six bridges across the river near Arkansas City from 8 to 12 feet in height above the

surface of the water, two railroad and four wagon bridges; that he didn't know whether the bridges were much of an obstruction to navigation at present; that the river was not navigable at Arkansas City at the present time through these bridges; that it would depend upon the size of the boat whether the river was navigable before the bridges were put in (373, 374).

I. H. Bonsall, who had lived in Arkansas City since July, 1872, testified with respect to the navigability of the Arkansas River as follows (383):

That he wrote an article entitled "Navigation of the Upper Arkansas River," which was published in the biennial report of the State board of agriculture of Kansas, Volume VI, for the years 1877 and 1878, on page 159. This article refers to the steamboat called the *Aunt Sally*. That said boat came to the mouth of the Walnut, at Arkansas City, June 30, 1878; that he procured the boat to make the trip; that he had a scheme to make the river navigable and that the appropriations from Congress to improve the river in Kansas was gotten by him through letters to Senators Ingalls and Plumb and Congressman Ryan; and that the *Aunt Sally* was about 125 feet long. On pages 384, 385, and 386 is a copy of the article referred to by witness. Witness further testified on direct examination (386) that the *Aunt Sally* was not built at Arkansas City; that soon after it came to Arkansas City the Sante Fe Railway Company submitted a proposition to bond the county to build from Wichita down; that a boat called the *Cherokee*, 125 feet long, was built at Arkansas City; that it went down the river with a load of wheat about November, 1878, but never came back; that several boats were completed here; and that the Pruden boys built a barge and loaded it with several hundred bushels of wheat and went down the river and sold the wheat below.

Cross-examination by counsel for Colorado (386, 387):

That of the boats described by him he never saw any of them after 1878 and never knew of one to return after it had gone down the river; that at the time the *Aunt Sally* was here the running of boats to Arkansas City was a hobby with him; that the *Aunt Sally* went down empty, it didn't go above the mouth of the Walnut; that the barge the Pruden boys built was about 25 feet long and 16 feet wide; that the *Cherokee* drew about 15 inches of water.

Cross-examination by counsel for intervenor (388):

That some Government engineers came to Arkansas City and came down the river in flats. This was after he had written the article referred to. Subsequently $15,000 was spent to improve the river between Arkansas City and Wichita. Witness didn't know whether Congress made any appropriation after the engineers referred to had made their report.

J. R. Mead, in rebuttal, who had lived in Wichita since 1868, testified, among other things (2127, 2139):

That in 1872 there was a steamboat built at Wichita which ran from Douglas avenue about a mile and a half downstream during high water to an island where they had picnics; that he saw some boats built at Wichita; that he heard that one boat went to Florida; that he saw house boats of considerable size by which parties went down to the State of Arkansas; that he saw a boat which he was told came from Pueblo down to Wichita; and that there were small boats at the end of the bridge for local use.

James Benedict, hardware dealer in Arkansas City, and who had lived there since 1870. Direct examination by counsel for Kansas (396, 397):

That he remembered the *Aunt Sally;* that it stayed at Little Rock about a week; that it came to Arkansas City to see whether the river was navigable; that he invested $200 in the *General Wiles*, which was built in Ohio, but never got farther than Fort Smith, as the engines were not powerful enough; that a boat called the *Cherokee*, fifty or sixty feet in length, was built at Arkansas City. Its power was a threshing-machine engine; that a boat ran there for a while called the *Necedah;* that a boat called the *None-Such* came up the river and then went down; that a boat called the *Kansas Millers* was built by the people of Arkansas City in 1884 for trading down the river. Its power was steam; that some barges were built for freighting wheat down the river. Thinks the river was navigable for shallow boats for six or eight months of the year.

Cross-examination by counsel for Colorado (398):

That the river to Arkansas City is navigable for shallow boats a portion of the year—small steamboats. Never knew of any steamboat coming back that had once gone down the river. That the river was navigable one way only (398). That there are four wagon bridges and two railroad bridges across the river at Arkansas City. They are built simply high enough to accommodate the highest water. They don't always do it. That the Arkansas River is a stream of shifting sands and changing channel; sand bars are formed and shift the channel from one side to the other and the river is treacherous.

On cross-examination by counsel for intervenor, witness said in effect:

That he knew very little about navigation. That at certain times of the year now there were times when the river contains water sufficient to float barges to Little Rock. For a month or six weeks during the year they could be floated below the Walnut.

W. H. Speers, direct examination by counsel for Kansas, among other things, said in effect (405):

That at one time he and one Amos Walton put a threshing-machine engine on a ferryboat and ran it about four months up as high as Oxford, 50 miles above Arkansas City, and the Kaw Agency, 35 miles below Arkansas City.

On cross-examination by counsel for intervenor, witness stated, among other things, in effect (407), that the *Kansas Millers* drew about thirty inches of water.

It is evidence (368) that the Walnut empties into the Arkansas River about 2½ miles southeast of Arkansas City, and that the *Aunt Sally* did not go above the mouth of the Walnut. There is no direct evidence as to the relative size of the two streams at the mouth of the Walnut.

On cross-examination of witness Carpenter the following was developed in respect to the navigability of the river in Kansas in former years (757):

On direct examination I made an extract from Major Pike's work found on page 445. On the same page appears the following: "The Arkansas appeared at this place to be much more navigable than below, where we first struck it, and for any impediment I have yet dis-

covered in the river, I would not hesitate to embark in February at its mouth and ascend to the Mexican Mountains with crafts properly constructed."

The witness states in connection with the above that he thinks Major Pike, in speaking of "crafts properly constructed," meant only canoes and buffalo boats or buffalo skins, and that when Major Pike refers to the river being navigable in the upper part, that navigation was for buffalo-skin boats or for canoes.

Witness further states that in the work of E. E. Hale, entitled "Kansas and Nebraska," there is found on page 115 the following: "It is said, however, that a steamboat can ascend at full water within twenty-four miles of the Great Bend, the point where the river gains its greatest northern latitude." Witness adds that Mr. Hale evidently was not stating the above on his own knowledge (757).

Witness further states on direct examination in referring to Executive Document 90, in 49th Congress, first session, and at the bottom of paragraph 2 of the date of 1886, the following sentence is found (759): "There is no doubt but that a two-foot channel can be provided whenever the development of the country warrants it, and the river should be for all purposes of law rated as navigable to Wichita, Kansas."

Witness further stated (1852) that in his testimony he quoted a paragraph from a report of J. D. McKown, assistant engineer, found in Executive Documents, third session, 45th Congress, and that in that report the following appears (1854):

"That portion of the country tributary to the river in Kansas, from Wichita to the State line, is rich, fertile and well cultivated, and would derive great benefit from the opening of the river to navigation. But where so much of the river passes through an almost uncultivated country, it is questionable whether the expenses of the improvement would be justifiable."

J. R. Sites, a witness for Colorado, who had resided on the banks of the Arkansas River in Sedgwick County, stated, among other things (6471 of the original transcript, printed record 1715), on cross-examination by counsel for complainant:

"Q. It has been navigable for the last few years, has it?

"A. Oh, it never was navigable, only in theory, for flatboats.

"Q. Has it been navigable the last few years?

"A. Just as navigable as it was before that."

William L. Sibert, a major in the Corps of Engineers in the United States Army, a graduate of West Point in the class of 1884, and who was engineer in charge of the Little Rock Harbor district, comprising the Arkansas, White, and other rivers, from 1894 to 1898, testified in effect upon direct examination as follows (1295):

That when he was at Little Rock navigation extended from the mouth of the river to a point above Fort Smith and below Fort Gibson; that small boats out of Fort Smith during the cotton season went up the Arkansas River to get freight; that they didn't go any farther than Fort Gibson, if they went that far.

Cross-examination by counsel for complainant (1296):

That when the river was at a low stage there was no practical navigation above Fort Smith, and navigable only at times when rainfall had produced two or three feet of water above low water; that

ordinarily the head of navigation was considered to be Fort Gibson.

L. P. Drake, who had lived at Little Rock for thirty years, and began boating on the river in 1855 and continued until five or six years before March, 1905, testified on direct examination, in effect (1298):

That Fort Gibson was the head of navigation.

Cross-examination by counsel for complainant (1299):

That the river was not navigable at all times of the year between Fort Smith and Fort Gibson, and not navigable generally in the summer and sometimes in the fall.

Edwin Huston, who had resided at Little Rock about forty years, and been engaged in boating on the river since 1855 between its mouth and Fort Gibson, testified, in effect (1300):

That when he first came to Little Rock Fort Gibson was considered to be the head of navigation.

Cross-examination by counsel for Kansas (1301):

That between Little Rock and Pine Bluff (which is below Little Rock) the river was not navigable half the time; that it has been in that condition ever since the war.

David D. Chapman, who had plied the river as a boatman for forty years and until about 1898, testified in effect (1304):

That he was the captain of the *Aunt Sally*, the boat referred to by complainant's witness, Mr. Bonsall; that he was offered $700 to take the boat to Arkansas City; that to get this money he made the trip; that they were fifteen days in going from Little Rock to Arkansas City and twelve days in getting back; that he had difficulty in getting back with the boat; that Fort Gibson was considered the head of navigation when he began to ply the river; and that he would not consider the river navigable above Fort Gibson.

Cross-examination by counsel for Kansas (1305):

That he was fifteen days going with the *Aunt Sally* from Little Rock to Arkansas City; that they ran in the day time only and laid up over night; that they were only about eight days on the back trip; that going down they went with the current; that they met two or three pretty good rises on the way up; that there was less water in the river coming down than there was going up (1305); that the boat drew two feet of water when loaded; that they had no load going down, the reason being that the river was falling rapidly, and that he knew enough about the river to know that if he didn't get out soon he wouldn't get out; and that after going to Arkansas City with the *Aunt Sally* he never again went up as far as Fort Gibson, but only to Fort Smith (1306).

Cross-examination by counsel for Colorado (1307):

That while at Arkansas City the water fell rapidly in the Walnut; that when he arrived there it had about twenty feet of water, and that when he left cattle could ford across the Walnut in front of his boat (1307); that he regarded the stream above Fort Gibson as very treacherous and incapable of practical navigation; that witness did not think there is money enough in the United States Treasury to make the river navigable the year round under any conditions whatever (1308).

P. R. Van Frank, jr., a civil engineer for the War Department, residing at Little Rock, and who served under Major Sibert from 1894–1898, and who at the time of his examination was serving under

Major Fitch, the successor of Major Sibert at Little Rock, upon direct examination, testified, in effect, among other things (1309, 1310):

That part of his duties were to make a report showing the navigation of the Arkansas River and the craft employed; that he had examined the report made by Major Fitch for 1904, which shows the list of vessels which navigated the Arkansas River from May 31, 1903, to June 1, 1904, and that the matter contained on page 2100 of that report, being Appendix W to the annual report of the Chief Engineers for 1904, is a correct statement of the vessels that plied on the Arkansas River, and that he had prepared said statement.

This exhibit was offered as Intervenor's Exhibit No. 2, and is as follows:

List of vessels that navigated Arkansas River from May 31, 1903, to June 1, 1904.

Name.	Net tonnage.	Draft loaded.		Between—	Round trips.	Passengers.
		Steamer.	Barges.			
		Ft. in.	*Ft. in.*			
Quickstep	66	3 0	3 6	Arkansas City and Garland Lake	68	1,000
Thurman	16	1 6	3 0	Little Rock and Perryville	16	.....
Roan	39	2 0	.....	Rafting out of lower river to Arkansas City.	(?)	.....
Victoria	12	2 6	.....	do	10	.....
Hazel Rice	138	3 6	6 0	Helena and Smith Cut-off	10	.....
J. N. Harbin	266	3 0	.....	Memphis and Victoria	1	964
				Memphis and Swan Lake	3	
				Memphis and Pine Bluff	22	
Lucille Nowland	292	5 0	.....	do	25	833
Delta	571	6 6	.....	Memphis and Little Rock	1	220
A. D. Allen	67	4 0	.....	Little Rock and Pine Bluff	30	280
				Little Rock and Littles	1	4
Dardanelle	164	3 6	3 0	Little Rock and Pine Bluff	10	250
				Little Rock and Cardens Bottoms	10	
				Excursion trips	44	8,800
Henry Sheldon	220	3 6	.....	Little Rock and Shoal Creek	2	14
				Little Rock and Cardens Bottoms	6	
				Excursion trips	23	5,672
				Little Rock and Pine Bluff	12	.....
Mary D	40	2 6	.....	Fort Smith and Webbers Falls	15	.....
Nettie	64	2 0	3 0	Towing to Garland Lake	(?)	.....
Wash Honshell	135	3 6	6 0	Cairo and Smith Cut-off	4	.....
Climax	(?)	3 0	.....	Rafting out of lower river to Arkansas City.	28	.....

Classification of commerce reported, year ending May 31, 1904.

Articles.	Tons.	Articles.	Tons.
Cotton	2,652	Railway ties	3,223
Cotton seed	5,025	Crushed rock	3,564
Grain	3,516	Square timber	1,300
Lumber	2,273	Gravel	3,498
Provisions	3,088	Miscellaneous freights	4,503
Saw logs	51,020		
Staves	6,149	Total tonnage reported	92,061
Cement	2,060	Estimated value	$2,079,888

(20) THE EFFECT OF IRRIGATION ALONG THE UPPER REACHES OF THE RIVER UPON ITS NAVIGABILITY BELOW.

The witness Sibert (1295) stated, in effect, on direct examination, that he made a study in respect to the effect that irrigation along the river had upon navigation where he was stationed; that his de-

ductions therefrom were that he could not establish from records and history, or any data that he could obtain, that the low-water discharge of the river had been decreased in consequence of irrigation; that from his investigation the stages of the river in its navigable portions are determined by rainfall almost entirely from points in Kansas down to the mouth of the stream; that he had made a report in respect to the effect of irrigation upon the upper portion of the river to the Chief Engineer of the United States Army; that this report was made in response to a letter written to the Secretary of War by one J. T. Smith, of Bentley, Kansas. This letter was in respect to the so-called "underflow;" that the Secretary of War referred the letter to him on one point, viz., as to the effect of irrigation on navigation; that this letter was written January 12, 1898, and witness made a report April 21, 1898 (1295–1296).

On cross-examination by counsel for Kansas (1296) witness stated, among other things, in effect:

That at the normal or average flow of the river a small proportion thereof above Wichita passes Fort Smith, and at extremely low water very little, if any.

Cross-examination by counsel for Colorado (1297):

That when he made the report referred to he could not establish the fact that there had been any diminution of the water in the river in consequence of irrigation; that his conclusion from his investigation would be that when he was at Little Rock that the river was good for navigation as it had been between 1860 and 1870; that he did not discover anything in regard to the flow of the river west of the Colorado line that would materially affect the navigability of that portion of the stream that was considered navigable; that there was no considerable amount of navigation on the Arkansas as high up as Fort Gibson when he was at Little Rock; and that in his investigations he had not discovered (1297) anything that indicated that the use of water from the river in Colorado had any effect upon the waters of the river below Little Rock (1298).

Redirect examination (1298):

"That more than half the year was a period of low water at Little Rock when he was there; that there was practically no navigation between Fort Gibson and Little Rock during the low-water period; and that from his investigations, etc., his conclusion was that the low-water stage is no less now than it was before irrigation began in Colorado.

L. P. Drake testified, among other things, in effect (1298):

That he had observed the flow of the river during the high and low water seasons since he had been boating—1855, and that he thinks the volume of water in the river is about the same now as then.

Cross-examination by counsel for Kansas (1299):

That they were in the habit of using small stern-wheel boats propelled by steam; that he had not been to Fort Gibson for ten or fifteen years. Could not say whether the river was as large now at Fort Gibson as it was fifteen years ago,; and that between Little Rock and Pine Bluff the river gets so that it can not be navigated.

Cross-examination by counsel for Colorado (1299):

That when he quit the river four or five years ago he did not see any difference in the flow of the water as compared with what it was

formerly, and that he did not know of anything that would lead him to believe that the flow of the river was less at Little Rock during the last four or five years than formerly.

Redirect examination (1300):

That he had seen the river at times when it was not navigable from Little Rock to its mouth and had been so low at Little Rock that a boat had not been in for two or three years.

Edwin Huston. Direct examination (1300):

That the river as near as he could tell was about the same as when he came to Little Rock forty years before; that the river would be navigable now just as it was before the war if business justified it, and they had boats to navigate and would pay just as it formerly did and that they would have no more difficulty in navigating it now than formerly.

Cross-examination by counsel for complainant (1301):

That the river in later years has not gone dry between Little Rock and Pine Bluff; that they had different boats formerly than now; and that if they had the same boats now as before the war they could navigate the river just the same and as for as long a time during any one year.

Recross-examination by counsel for Colorado (1303):

That the amount of boating on the river in late years had fallen off 90 per cent, not on account of any change in the river between Fort Gibson and its mouth, but from competition by railroads on both sides; that with the same character of boats to-day as they had before the war the same navigation can be carried on; that the railroads have run the boatmen out of business; that he could not see that there was any difference in the width or depth or flow of the river from what it was formerly.

David D. Chapman. Direct examination (1304):

The river is not as deep as formerly, but wider.

And on page 1305 he states:

That the river is three times as wide at Little Rock as it was in 1856, and that to make the river navigable with modern boats would require an expenditure of money not warranted.

Cross-examination by counsel for complainant (1307):

That he did not think that if all the water was taken out of the river above Wichita it would make any perceptible difference in the flow at Little Rock.

Again he says, however—

That it would make a difference and a very great difference because there are several streams coming in.

P. R. Van Frank, jr., among other things, testified, on direct examination (1309), in effect:

That he gathered data upon which Major Sibert made the report referred to by the latter in his testimony; that from his investigations he could not find that irrigation in Colorado had any effect upon the flow of the river at Fort Gibson; that if it had affected it he couldn't find any records to prove it; that he had made a pretty thorough investigation; that he had interviewed old citizens and examined historical documents; that he had continued his investigations since making that report (1309); that he wouldn't say there had been any appreciable decrease in the flow of the Arkansas River from Fort Gibson

to its mouth since April, 1898; that the taking the water out of the river above Wichita at an ordinary stage of the river would not be noticed at Little Rock; that the taking out of a stream at a point above Wichita in the ordinary stages of the river might have an appreciable effect in the vicinity of Fort Gibson; that if the low water of the river was taken out above Wichita it would not affect low water flow of the river at Fort Gibson or at the mouth of the Grand just below; and that there is no regularity in the current and no stability in the channel of the river from Fort Gibson to its mouth.

On cross-examination by counsel for complainant (1311):

That he keeps a gauge record; that a gauge reading of one foot shows that there is a flow in the river of 1,100 second-feet; a gauge of 13 feet would indicate anywhere from 150,000 to 225,000 second-feet; a gauge reading of 24 would show 350,000 second-feet; that the average gauge reading for a period of years is 7.8, which shows an average of between 15,000 and 17,000 second-feet; a gauge reading of 2.5 would show between 2,500 and 2,750 second-feet (1311); that if in 1896 there was 150 second-feet in the river at Hutchinson, and in 1897 175 second-feet, that amount might be taken entirely from the flow of the river and would not be noticed in the measurements at Little Rock, and that if the low water flow above Wichita were taken away or if its average flow were entirely withdrawn the effect would not be noticed in the river at Little Rock for the reason that the part of the flow of the river which passes Little Rock comes from the tributaries below Wichita.

Cross-examination by counsel for Colorado (1313, 1314):

The river is one which goes up and down in a series of years. We may have four or five years' pretty good flow and four or five years of pretty low discharge. In the investigations which were carried on in connection with the report of Major Sibert we considered papers purporting to represent the early histories and we were unable to discover anything which would show that the use of water for irrigation in Colorado had interfered with the navigation of the stream from Fort Gibson to its mouth. In that report I stated: "The statements of channel depths covering a period of over 150 years do not show that these depths are decreasing," and in another place in comparing the gauge readings from 1872 to 1897 I say, "This comparison of gauge readings does not show that the river stages are getting lower."

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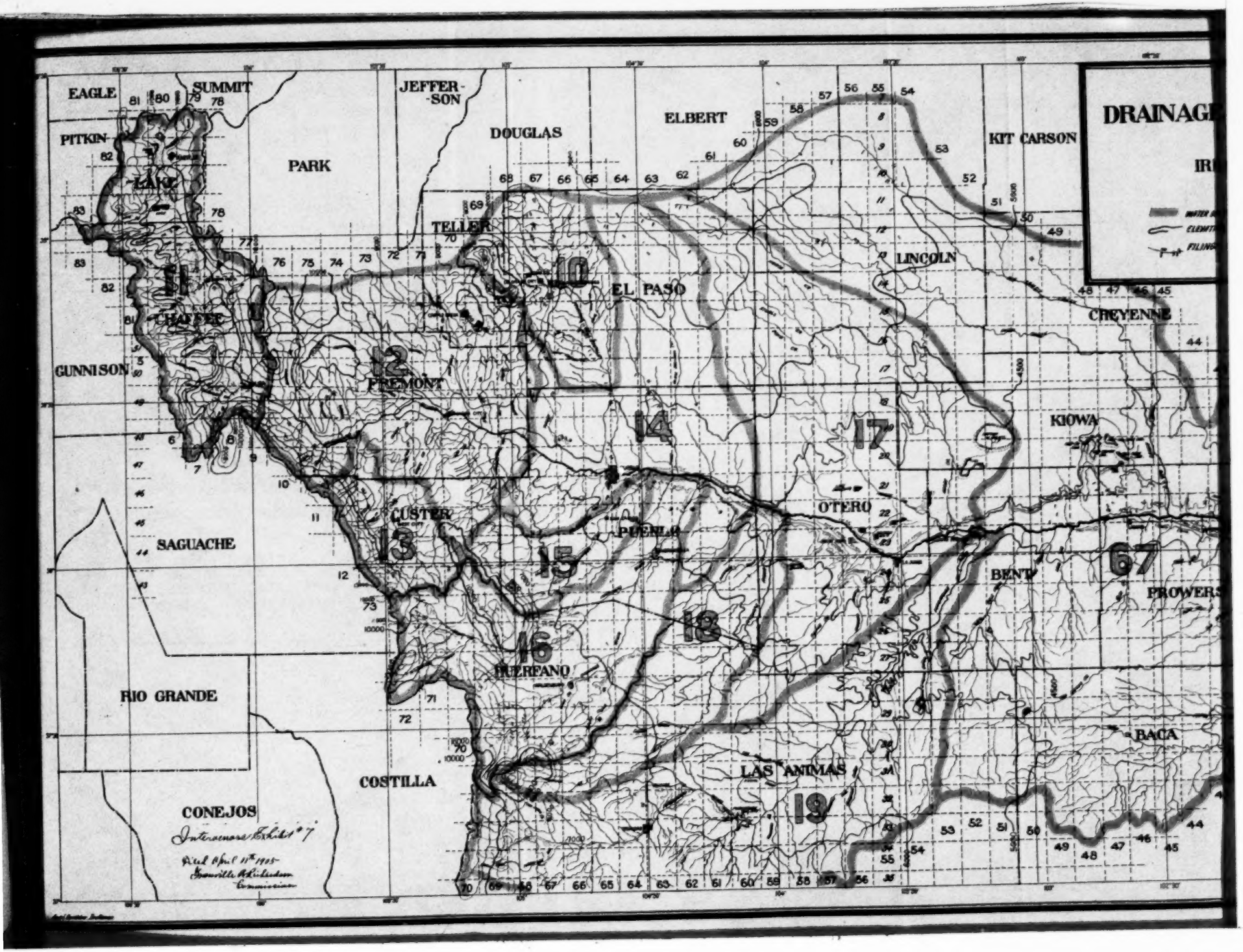
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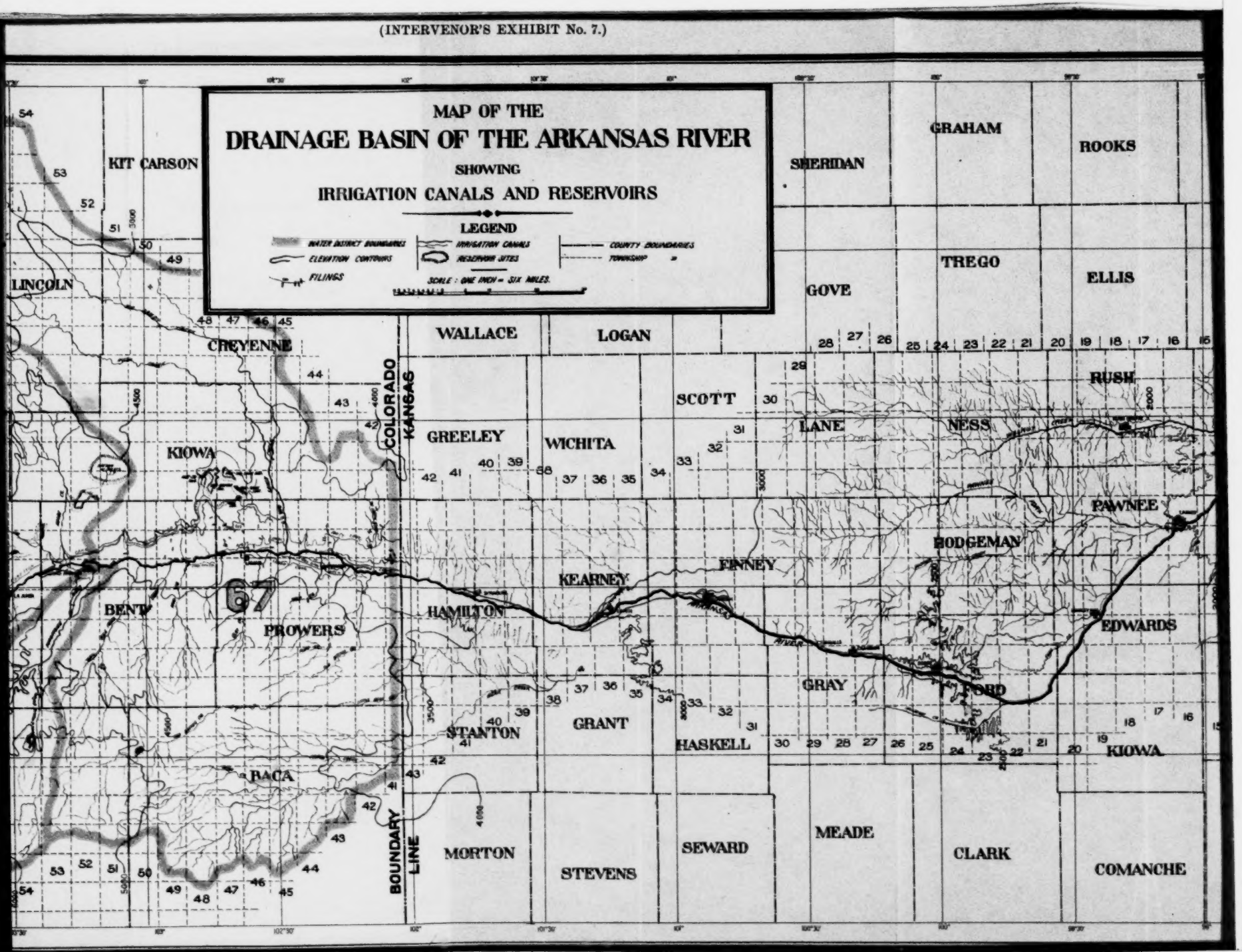

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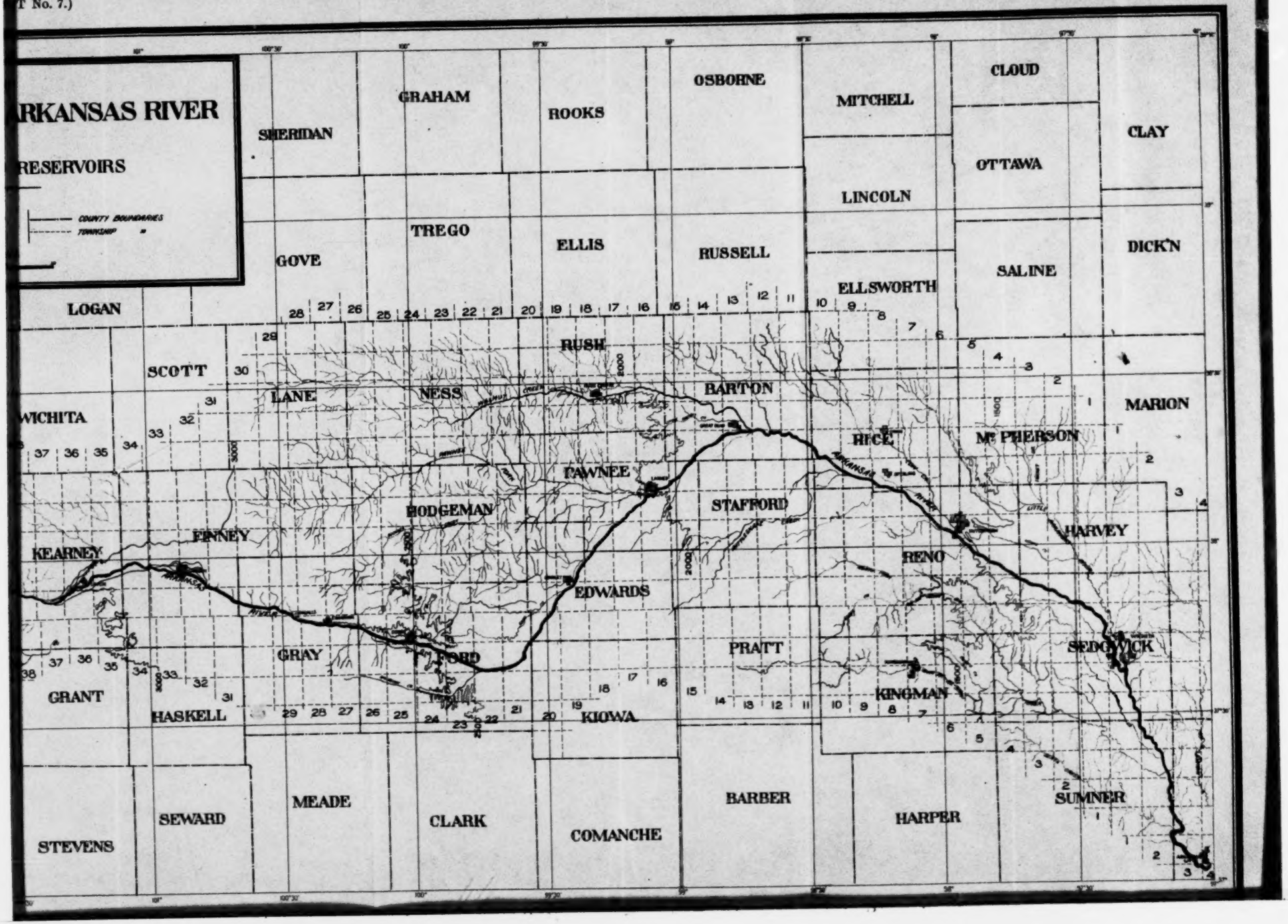
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No. 3, Original.

In the Supreme Court of the United States.

OCTOBER TERM, 1906.

STATE OF KANSAS, COMPLAINANT,

v.

STATE OF COLORADO ET AL. AND THE UNITED STATES; INTERVENOR.

SUMMARY OF SOLICITOR-GENERAL'S ORAL ARGUMENT FILED BY LEAVE OF COURT, WITH SOME ADDITIONAL CONSIDERATIONS.

In the Supreme Court of the United States.

OCTOBER TERM, 1906.

STATE OF KANSAS, COMPLAINANT,
v.
STATE OF COLORADO ET AL. AND THE United States, intervenor.

No. 3, Original.

SUMMARY OF SOLICITOR-GENERAL'S ORAL ARGUMENT FILED BY LEAVE OF COURT; WITH SOME ADDITIONAL CONSIDERATIONS.

We do not agree with either State. Their powers of internal police are exhausted at the boundary, and yet the effects are claimed to pass beyond. There is a conflict which only the national sovereignty is competent to settle.

As to the riparian law or modified riparian law of Kansas: it is clear that she wishes the water to flow to her as it was accustomed to flow, but not beyond. She wishes to irrigate, too; she complains of Colorado, but will not regard Oklahoma below. She can impose the riparian law in any form she chooses so that it operates wholly within her own borders, and no other power can interfere because so far she is completely sovereign; but

what she really claims is to impose her law extra-territorially upon Colorado.

Assuming that there is power somewhere outside the two States to adjust the dispute, the principle of law to be found and applied will inaugurate a new law of waters on interstate streams—that is, on main streams which actually cross State lines. The strict common-law rule of riparian rights can not control this new law for the arid region. The common law would not be the pervading and permanent institution which it is if it had not contained the seeds of growth and free development; not to break down constitutions and laws, but to adapt them to new times, places, and conditions. In *Hurtado* v. *California* (110 U. S., p. 531), the court said:

> As it was the characteristic principle of the common law to draw its inspiration from every fountain of justice, we are not to assume that the sources of its supply have been exhausted. On the contrary we should expect that the new and various experiences of our own Constitution and system will mold and establish it into new and not less useful forms.

Chief Justice Peters said in *Woodman* v. *Pitman* (79 Maine, p. 458):

> The inexhaustible and ever-changing complications in human affairs are constantly presenting new questions and new conditions, which the law must provide for as they arise; and the law has expansive

> and adaptive force enough to respond to the demands thus made of it, not by subverting, but by forming new combinations and making new applications out of its already established principles, * * *

Irrigation was always a common-law use, and a "new combination" of the common law is taking shape here, because the doctrine of reasonable use is qualifying the unrelieved common-law rule. In *Clark* v. *Nash* (198 U. S., 361) the court approved the idea of an evolution of law to meet new conditions and necessities, as follows (p. 370):

> The rights of a riparian owner in and to the use of the water flowing by his land are not the same in the arid and mountainous States of the West that they are in the States of the East. * * * This court must recognize the difference of climate and soil, which render necessary these different laws in the States so situated.

That case, it is true, related to rights wholly within a Territory. But if sovereign power to deal with the present controversy exists, the idea of the necessary modification of law is applicable throughout the arid regions irrespective of State lines.

As to the Colorado claim to do as she pleases as a matter of sovereign right: In Wyoming, under a similar clause in her constitution, it is not now maintained that the upper State can take all

the water of an interstate stream regardless of prior appropriators in the lower State. The claim means in the last analysis the right to make war, which with the right of compact was surrendered by the States. The very fact that the controversy is justiciable here is proof that Colorado can not do as she sees fit without accountability. She is a sovereign State of this Union, but not a sovereign nation. There is a higher sovereignty. "All the States have transferred the decision of their controversies to this court." (*Rhode Island* v. *Massachusetts*, 12 Pet., at p. 743.)

The defendants invoke a sentence from *Mannville Co.* v. *Worcester* (138 Mass., 89) stating that Massachusetts "might authorize any acts to be done within its limits, however injurious to lands or persons outside them." But that was a State case, and the opinion expressly disclaimed any consideration of constitutional principles; the contention of the defendant was that a servitude can not be created in one State in favor of lands in another, which the court disapproved upon principle and authority; and the point actually adjudged was that "an action of tort for diverting the waters of a natural stream in this Commonwealth and preventing the same from coming to the plaintiff's mill in an adjoining State may be maintained in this Commonwealth."

As to the fundamental question: Is there power anywhere to compose this dispute? This court is

a branch of the *sovereign* power of the nation. It has taken jurisdiction of such controversies between States under its constitutional grant of authority, and has acted upon them with conclusive effect. The people rest confidently on the power and competence of the court always to adjust any controversy between States coming within its jurisdiction as defined by the Constitution and statutes. Probably there is no important cause between States capable of statement in equity and demanding relief in equity which the court would not now adjudicate if clearly proven.* But the court thus called upon to discover and apply some principle of law which will solve the controversy has said more than once that it is not a legislature. Beneath the judicial *jurisdiction*, and controlling it, there appears always the inquiry as to the basis in *power* and competence for national intervention in any form.

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*Consider, however, the meaning and consequences of Chief Justice Taney's view in *Rhode Island* v. *Massachusetts* (4 How., at p. 640):

> For if Rhode Island had proved herself to be justly and clearly entitled to exercise sovereignty and dominion over the territory in question, and the people who inhabit it, yet my judgment must still have been, that the bill should be dismissed, upon the ground that this court, under the Constitution of the United States, have not the power to try such a question between States, or redress such a wrong, even if the wrong is proved to have been done.

I suppose the learned chief justice meant that the only recourse was for the large and strong State and the small and weak State to reach a boundary agreement and submit it to Congress for approval.

The opinion on the final hearing of the Chicago drainage case (*Missouri* v. *Illinois*, 200 U. S., 496) is most significant here. The court adjudged the case, although the suit would almost necessarily have failed if it had been brought fifty years ago, as the opinion states. The language describes the nature and grave importance of the issue as a controversy between States over the pollution of interstate waters; the scope of the decision is carefully restricted; nothing is intimated as to Federal power in such a controversy; but it is noted that Congress had not acted on the matter, and an obvious inference is that the sovereign power of Congress as well as the sovereign power of this court might deal with such a controversy.

Commerce is intercourse, and it may well be, under the famous definition of Marshall (*Gibbons* v. *Ogden*, 9 Wheat., at pp. 189, 190) and the principles of constitutional expansion which he laid down, that the word imports intercourse in the broadest sense. That is the tendency of later decisions of the court following Marshall's definition. The word means all sorts of communications and correspondences, dealings, comminglings, and interchanges. One secondary definition is "the dealings of one person or class in society with another." (Webster.) "Fifteen years of thought, observation, and *commerce* with the world had made him [Bunyan] wiser." (Macaulay.) The word is not restricted to trade and traffic, or navigation or transportation; no one can

now say definitely what movements and interactions across State lines may not be embraced within its meaning. When to the power over interstate commerce, so regarded, the powers necessary to carry that power into effect are added, it may well be that conflicting irrigation rights between two States on the waters of a stream passing from one State to another involve the power over interstate commerce. Water is sold for irrigation and flows downstream and along ditches to the point of delivery. The "Amity" ditch, beginning in Colorado, was constructed to deliver water in Kansas. (Rec., p. 1429.)

Furthermore, implied power becomes appropriate and legitimate here by reason of the Federal relation. Just because it is a controversy between two States, the sovereignty between them and above them both must harmonize. The power in Congress to make necessary and proper laws is given not only "for carrying into execution the *foregoing powers*," but also "all *other* powers vested by this Constitution in the Government of the United States." The "other powers" are especially needed to adjust and preserve the Federal relations between States.

But assuming for the purpose of argument, without at all conceding, that this case does not clearly fall within an enumerated power and the implied powers necessary to effectuate it, I come to the doctrine of sovereign and inherent power. I am aware that in advancing that doctrine I seem to

challenge great decisions of the court, and I speak with deference. It is more than a theory. It is well recognized. It is indeed established, although its full development is of recent date; and in clear and concrete form it has perhaps only been applied once. And first it must be said that there is no sharp line between implied powers and inherent powers. The expansion of implied powers and the existence of inherent powers lie close together.

"This Government is acknowledged by all to be one of enumerated powers." (Marshall in *McCulloch* v. *Maryland*, 4 Wheat., at p. 405.) "The Government, then, of the United States can claim no powers which are not granted to it by the Constitution, and the powers actually granted must be such as are expressly given or given by necessary implication." (Story in *Martin* v. *Hunter's Lessee*, 1 Wheat., at p. 326.) "The Government of the United States is one of delegated, limited, and enumerated powers." (*United States* v. *Harris*, 106 U. S., at p. 635.) Yet Marshall also said in the same passage: "But the question respecting the *extent of the powers actually granted* is perpetually arising and will probably continue to arise as long as our system shall exist." And Story said, in the case cited:

> Where a power is expressly given in general terms, it is not to be restrained to particular cases unless that construction grows out of the context expressly or by necessary implication. * * * It did not suit the

> purposes of the people in framing this great charter of our liberties to provide for minute specifications of its powers, or to declare the means by which those powers should be carried into execution. * * * The instrument was not intended to provide merely for the exigencies of a few years, but was to endure through a long lapse of ages, the events of which were locked up in the inscrutable purposes of Providence. It could not be foreseen what *new changes and modifications of power* might be indispensable to effectuate the *general objects* of the charter; and restrictions and specifications which at the present might seem salutary might in the end prove the overthrow of the system itself. Hence its powers are expressed in general terms, leaving to the legislature, from time to time, to adopt its own means to effectuate legitimate objects, and to mould and model the exercise of its powers as its own wisdom and the public interests, should require.

Chief Justice Marshall also said in *Gibbons* v. *Ogden* (9 Wheat., at p. 195):

> The *genius and character of the whole Government* seem to be that its action is to be applied to all the external concerns of the the nation, *and to those internal concerns which affect the States generally;* but not to those which are completely within a particular State, *which do not affect other States*, and with which it is *not* necessary to interfere for the purpose of executing *some of the general powers* of the Government.

Mr. Justice Wilson said, in his speech at the Pennsylvania Constitutional Convention of 1787 (Andrews' "Works of James Wilson," vol. 1, p. 533):

> Whatever object of government is confined in its operation and effects within the bounds of a particular State should be considered as belonging to the government of that State; whatever object of government extends in its operation or effects beyond the bounds of a particular State ment *extends in its operation or effects beyond the bounds of a particular State* should be considered as belonging to the Government of the United States.

This he said, contemplating the Constitution as framed and submitted to the people. He had expressed the same thought previously thus:

> Whenever an object occurs, to the direction of which no particular State is competent, the management of it must of necessity belong to the United States in Congress assembled. There are many objects of this extended nature. (Paper on Incorporation of Bank of North America, id., p. 558.)

The second Legal Tender Cases (12 Wall., 457) held that nonenumerated powers are included in the authority *expressly* given to make all necessary and proper laws "for carrying into execution the foregoing powers and *all other powers vested* by this Constitution in the Government of the United States or in any department or officer thereof."

That decision expressly held that by this provision a right was given to the Government "to employ freely every means, not prohibited, necessary for its preservation and for the fulfillment of its acknowledged duties."

> And here it is to be observed it is not indispensable to the existence of any power claimed for the Federal Government that it can be found specified in the words of the Constitution or clearly and directly traceable to some one of the specified powers. Its existence may be deduced fairly from more than one of the substantive powers expressly defined or from them all combined. * * * And that important powers were understood by the people who adopted the Constitution to have been created by it, powers not enumerated, and not included incidentally in any one of those enumerated, is shown by the amendments. * * * They tend plainly to show that in the judgment of those who adopted the Constitution there were powers created by it neither expressly specified nor deducible from any one specified power or ancillary to it alone, but which grew out of the aggregate of powers conferred upon the Government or out of the sovereignty instituted. * * * And it is of importance to observe that Congress has often exercised, without question, powers that are not expressly given nor ancillary to any single enumerated power. Powers thus exercised are what are called by Judge Story, in his Commentaries on the Constitution,

> resulting powers arising from the aggregate powers of the Government. (Per Mr. Justice Strong, pp. 534, 535.)

The opinion stands upon the development of the doctrine of necessary powers in *McCulloch* v. *Maryland*:

> It was, however, in *McCulloch* v. *Maryland* that the fullest consideration was given to this clause of the Constitution granting auxiliary powers and a construction adopted that has ever since been accepted as determining its true meaning. * * * Even in *Hepburn* v. *Griswold* both the majority and minority of the court concurred in accepting the doctrines of *McCulloch* v. *Maryland* as sound expositions of the Constitution, though disagreeing in their application. (Per Mr. Justice Strong, pp. 538, 539.)

Mr. Justice Bradley, concurring, declared that—

> The United States is not only a government, but it is a national government, and the only government in this country that has the character of nationality. * * * It has jurisdiction over all these general subjects of legislation and sovereignty which affect the interests of the whole people equally and alike. * * * Such being the character of the General Government, it seems to be a self-evident proposition that it is invested with all those inherent and implied powers which at the time of adopting the Constitution were generally considered to belong to every government as

> such and as being essential to the exercise of its functions. If this proposition be not true, it certainly is true that the Government of the United States has express authority in the clause last quoted [Art. I, sec. 8, cl. 18, as above] to make all such laws (usually regarded as inherent and implied) as may be necessary and proper for carrying on the government as constituted and vindicating its authority and existence. (pp. 555–556.)

That decision in the Legal Tender Cases was approved and affirmed in 110 U. S., 421, Mr. Justice Field alone dissenting. Mr. Justice Harlan was then, as now, a member of the court, and Mr. Justice Woods, who delivered the opinion in *United States* v. *Harris*, *ante*, was also a member of the court. The Legal Tender Cases in 12 Wallace were also cited with approval in the Debs case (158 U. S., at p. 579). I can not discover that they have ever since been doubted or shaken.

The logic is that since the Constitution says "all other powers *vested*," that means more than powers *enumerated* or powers expressly *delegated*. This is emphasized by the fact that Chief Justice Marshall speaks of this grant as "the *last* of the *enumerated* powers" (*Gibbons* v. *Ogden*, 9 Wheat., at p. 187). Then, other powers being granted besides the "foregoing," to which the power of making necessary laws is superadded, these other powers exist and are *vested*, although not enumerated or expressly delegated.

There can be no more obvious and necessary occasion for invoking the doctrine of inherent sovereignty and of implied powers (resting on Chief Justice Marshall's reasoning) than where there is a conflict of law and interest between two or more States. The "resulting powers" of Judge Story would most properly take effect there.

Whatever the particular matter of internal police may be, the respective "rights" or jurisdiction involved, whether Federal or State, should be measured by the test whether they concern only the rights of a State or its citizens *within* a State, or affect other States and their citizens and the citizens of the United States in general. The power of a State is restricted to its own organism and function as a separate entity of government. That power relates to the effective discharge of duties to its citizens and others within its own borders, affording a direct, complete, responsive, and exclusive control of all subject-matters essential to life, liberty, and property as between the inhabitants themselves in contradistinction from the complex relations existing to other States and their citizens.

Let me take a definition from a case sustaining the internal police of a State against the Federal power over commerce, in which (it should be noted) Justice Story dissented and announced that Chief Justice Marshall (then lately deceased), having heard the former arguments, his deliberate

opinion also was that the act of New York was unconstitutional:

> That all those powers which relate to merely municipal legislation, or what may, perhaps, more properly be called *internal police*, are not thus surrendered or restrained; and that, consequently, in relation to these, the authority of a State is complete, unqualified, and exclusive. * * * We should say that every law came within this description which concerned the welfare of the whole people of a State, or any individual within it; whether it related to their rights or their duties; whether it respected them as men or as citizens of the State; whether in their public or private relations; whether it related to the rights of persons or of property, of the whole people of a State or of any individual *within* it; *and whose operation was within the territorial limits of the State, and upon the persons and things within its jurisdiction.* (Per Mr. Justice Barbour in *City of New York* v. *Miln*, 11 Pet., 102, 139.)

Where State antagonism to another State or the nation begins, the State sovereignty ends, and that is at just the point where the matters of exclusive regulation within the State boundaries, the things done by or in the State, tend to pass over into the other limited sovereignties, and then the exclusive power, the reserved power, falls, or rather stops. The problem then does not involve the taking *away* prerogatives from a State wholly

operating within its own confines, but only involves the taking *up* these prerogatives at the State lines and supplementing them by national cooperation or control so as to amalgamate or reconcile the separate forces. There is a gap and vacancy of sovereignty somewhere if the sovereign and inherent power of one State is restricted to its own territory (which of course it is), and there is no sovereign and inherent power in the nation to regulate where the powers of two or more States overlap, and so clash, and injure each other and the aggregate interests. This entails no loss of powers reserved to the States; if it does we are in a vise—both the States and the nation powerless at the very point where competent power is most essential.

Since the States are contiguous and there is no physical gap at the boundaries, the derisive suggestion might be made that I should point out this vacuum which the nation may enter. I say that there is an interference and vacancy of *power*, not territory (for the United States in executing its legitimate powers operates over every foot of territory in the country), if the sovereignties of the States clash and the sovereignty of the nation can not step in.

What else does the current movement for uniformity in State legislation mean? That movement regards more, perhaps, the failure of State laws to meet than an overlap. It is lack of continuity and congruity rather than sharp conflict. I do

not intend to say that for this reason the Federal Government may constitutionally undertake to deal with all matters in which it is desirable to have common rules throughout the country, as, for instance, in the law of sales and warehouse receipts; but simply that where there is a direct interstate relation, bearing, and effect of the subject-matter, there is inherent and sovereign power in the nation to come to the relief or the control of the State sovereign powers which halt at the State boundaries. I do not mean to say, for instance, that there could be a national divorce law without an amendment to the Constitution. I volunteer no views on that subject. But it is nevertheless true that recent decisions of the court upon divorce have interposed between the conflicting laws of States and have initiated a national divorce law through the judicial power.

The sovereign power which I am endeavoring to define was never reserved to the States. In the nature of things it could not have been, being the power to restrain the State authority when by its necessary effect it passed beyond its own borders. This was the very pretension, or the very danger, rather, which all the States wished to put down in order that one State should not become prepotent. "Would the people of any one State trust those of another with a power to control the most insignificant operations of their State government? We know they would not." (*McCulloch* v. *Maryland*, 4 Wheat., at p. 431.)

The present Secretary of State speaks with the authority of an eminent public man as well as counsel learned in the law. The purport of his recent utterances on uniform State laws has been misconceived. He says that if one State maintains a law condemned by the public sense of the whole country, or lags and fails in the performance of its duty, then the instinct for self-government of the people is too strong to permit them long to respect anyone's right to exercise a power which he fails to exercise. His conclusion is that the States must awake to their responsibilities, must reassume and exercise their power. His searching words are a plea for more State power; greater State's rights, not less. But the desirability of uniform regulation in the purely internal affairs of all the States does not now concern us.

Would Federal administration and control of irrigation on interstate streams, subject to regard for the different State laws as directed by Congress, and always subject to the power and jurisdiction of this court to pass upon interstate controversies, encroach in any respect upon the powers reserved to the States or the people? "Besides Congress * * * has not assumed to interfere with the completely internal affairs of any State, and has only legislated in respect to a matter which concerns the people of the United States." (*Lottery Case*, 188 U. S., at p. 357.) The powers reserved to the States are powers confined wholly to their respective borders. The powers reserved to the people relate, I think,

to possible encroachments on their personal and individual rights of life, liberty, and the pursuit of happiness. At least the language of the tenth amendment can not reasonably mean that the underlying sovereignty of the people has thereby withheld from the sovereignty which they have created an essential branch of national power without which the Government is not completely sovereign within its sphere—essential because neither the separate States nor the people at large can deal with it effectively or indeed at all. To quote again from the great opinion in *McCulloch* v. *Maryland:*

> There is no phrase in the instrument which, like the articles of confederation, excludes incidental or implied powers, and which requires that everything granted shall be expressly and minutely described. Even the tenth amendment, which was framed for the purpose of quieting the excessive jealousies which had been excited, omits the word "expressly," and declares only that the powers "not delegated to the United States, nor prohibited to the States, are reserved to the States or to the people," thus leaving the question whether the particular power which may become the subject of contest has been delegated to the one government or prohibited to the other to depend on a fair construction of the whole instrument. (4 Wheat., p. 406.)

And it is to be observed that, speaking of the grant of power to the General Government, the great Chief Justice said that it "is an investment

of power for the general advantage in the hands of agents selected for that purpose, which power can never be exercised by the people themselves, but must be placed in the hands of agents or lie dormant." (*Gibbons* v. *Ogden*, 9 Wheat., p. 189.)

As to the decree: All that I have said assumes that the court will not dispose of the case on the facts, but will consider and apply the principles of law. We come, then, to the decree, and I submit that the claim of Kansas that the common law of riparian rights is in force in Kansas and subjects the Colorado law of appropriation to the riparian rights of Kansas, must be denied. The claim of Kansas that Colorado is not entitled to the whole flow of the Arkansas River under the doctrine of sovereignty and by virtue of her constitution and the law of prior appropriation should be granted. The claim of Kansas to sufficient water to sustain her vested rights established prior to appropriations for irrigation in Colorado should be granted, provided that these vested prior rights are also based upon appropriation.

In reference to the retention of the cause in order to enforce the rights found and declared, I submit that the function and power of the Government, on the legislative and executive side, in reference to the distribution of the flow of the Arkansas River, are involved in this case. It is difficult to see how the court can adjudge the law

of the case without considering the reclamation act of 1902. It is possible that not only the construction of that act as related to the present situation between Kansas and Colorado, but its constitutionality, is necessarily before the court. And the court would thus be led to consider the power of the Government and the authority of Congress to enact the existing or additional legislation.

The reclamation act not only provides for storage reservoirs on Government lands, but naturally contemplates irrigation systems which may cross State lines. The act speaks of interstate streams. While it imposes regard for State laws, it also recognizes and adopts the rule of prior appropriation for beneficial use. Doubtless respect for State laws must be absolute in relation to all matters wholly within a State and wherein there is no conflict between States, but that provision is limited necessarily to such matters and manifestly does not apply and can not control the Government when antagonistic State laws intersect and seek to occupy the same ground. Future acts of Congress may prescribe more exactly the sphere and details of the Government's relation to this interstate field.

I suggest that injunction with its compulsive processes might not adequately relieve; or if it would relieve a complainant State, it could not undertake to effect the complicated steps which

administering the law and equities here would naturally involve. If there is power in Congress as well as jurisdiction in this court, the subject seems to call for legislative action, for a scheme of administration and regulation, involving the settlement and enforcement of many legal and equitable rights. Congress might act by cooperating with but supervising and controlling State law and administration when interstate relations supervene; or Congress might act by conferring jurisdiction specifically upon the Federal courts, beyond the present categories of diverse citizenship, etc., to deal with irrigation controversies between individuals respecting lands in different States dependent on the same stream.

It is within the court's knowledge that not only may there be an irrigation conflict between States or Territories, but also between them and foreign nations, i. e., between the respective laws and interests. Consider the international situation as to the Rio Grande and the Colorado between Texas, New Mexico, Arizona, and Mexico; and as to the Milk River between Montana and Canada. In both the State case and the international case the United States alone can adjust.

I submit, therefore, that the decree should embrace in terms or in effect a recognition of the national law and of the Government's right to direct the matter of water distribution on this nonnavigable interstate stream.

What is the great principle here and whenever it is a question of conflict between States or between a State and the nation?

> This great principle is that the Constitution and the laws made in pursuance thereof are supreme; that they control the Constitution and laws of the respective States, and can not be controlled by them. * * * The sovereignty of a State extends to everything which exists by its own authority, or is introduced by its permission. * * * [The powers of Congress] are not given by the people of a single State; they are given by the people of the United States to a Government whose laws, made in pursuance of the Constitution, are declared to be supreme. Consequently, the people of a single State can not confer a sovereignty which will extend over them. (*McCulloch* v. *Maryland*, at pp. 426, 429.)

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No. 3 Orig.

Office Supreme Court
FILED
MAY 20 1901
JAMES H. McKENNEY,
Clerk

Motion for Leave to File Brief for

IN THE State of Colorado

SUPREME COURT

Filed May 20, 1901.

OF THE

UNITED STATES.

THE STATE OF KANSAS,
Complainant,
vs.
THE STATE OF COLORADO,
Defendant.

3 Orig'l.
O. T. 1906

PETITION FOR LEAVE TO FILE BRIEF
CONTRA COMPLAINANT'S MOTION.

CHAS. C. POST,
Attorney General of Colorado.

THE SMITH-BROOKS PRINTING CO. DENVER.

IN THE

SUPREME COURT

OF THE

UNITED STATES.

THE STATE OF KANSAS,
Complainant,

vs.

THE STATE OF COLORADO,
Defendant.

PETITION FOR LEAVE TO FILE BRIEF CONTRA COMPLAINANT'S MOTION.

Special Appearance.

Comes now the defendant State, by its Attorney General, thereto duly directed by the Honorable James B. Orman, governor of said state, and likewise

thereto duly directed by resolution of the Thirteenth General Assembly of said state, passed on the 16th day of April, A. D. 1901, and appearing specially for the purpose of resisting the motion for leave to file the bill exhibited by the complainant, presents this petition for leave to file brief *contra* complainant's motion and has deposited with the clerk of this Honorable Court twenty-five printed copies of said petition and the argument in support of the same, and as reasons why the defendant State should be heard *contra* the motion, respectfully represents and shows to this Honorable Court:

Political Questions Involved. Property Rights Subordinate.

In paragraphs numbered 8, 9 and 16 of its motion for leave, complainant asserts English Common Law riparian rights.

The Territory involved came in part by political cession to the United States in 1803 as parcel of the Louisiana purchase; in part by cession from the State of Texas in 1850. Following these cessions came the organization of Kansas Territory in 1854 and its State admission in 1859.

Between these dates came the secession of Texas from the Mexican Republic, the admission of Texas, the Mexican war and its political conclusion in the treaty of Guadaloupe Hidalgo in 1848.

During the entire intervening period water appropriations were being asserted and perfected by private acquisitors. The decision of property rights thus invited involves the preliminary ruling upon political questions as to the extension of the Federal Constitution, *ex proprio vigore,* or by congressional

enactment over new territory acquired in various ways and the effect of Territorial organization and State admission, of far greater importance than the property rights; making such property rights wholly subordinate to the greater political questions involved.

Defect of Parties Defendant in Colorado.

It is shown on the face of the bill that in 1854 the Territory of Kansas was organized, embracing all the waters in controversy within the limits of the state of Colorado (page 21 of bill), and that, by reason of prior settlement and occupation, people living along that part of the Arkansas river now embraced within the limits of the state of Colorado, acquired rights to said waters, and this court is now asked to adjudicate the same without making such residents of Colorado parties to the bill. It is shown on the face of the bill (paragraph 2, page 15) that under the constitution and statutes of the State of Colorado 150 persons, firms and corporations have acquired rights to divert waters from the Arkansas river, none of whom are made parties to the bill.

Defect of Parties Plaintiff in Kansas.

It is shown on the face of the bill that the valley of the Arkansas embraces 2,500,000 acres (second paragraph, page 3 of bill), of which 1,000,000 acres are owned by the Atchison, Topeka & Santa Fe Railroad Company (paragraph 4, page 8, of bill), the remainder by private parties, and the complainant State owns but 526.56 acres (pages 11 and 12 of bill), and

neither said railroad company nor said private persons are made parties to the bill.

The Arkansas River Non-Navigable.

It is shown on the face of the bill that all the greater riparian rights can not be maintained on the river, as it is non-navigable. That it has a normal flow of but 2,000 cubic feet per second (if entirely appropriated capable of watering but 110,000 acres), with an average grade of about 7.5 feet per mile, and that it is only navigable to Fort Gibson, a point far beyond the limits of the state of Kansas (pages 2 and 3 of bill), showing the fact that by reason of the small volume and excessive grade navigation is physically impossible to known methods of water travel.

Abrogation of State Constitution.

The bill seeks to abrogate the obligations of the United States toward the people of Colorado which arose by reason of their compliance with the act generally known as the Enabling Act approved March 3, 1875, 18th U. S. Statutes at Large, page 474, by which said State, with the consent of congress, adopted sections 5 and 6 of article XVI of its Constitution, which has been acquiesced in for more than twenty-four years.

Abrogation of Acts of Congress.

The bill seeks to enjoin the legislation of congress enacted to promote the settlement and development of the lands of the United States within the

state of Colorado, and over which the state has no control, being an act entitled "An act making appropriations for sundry civil expenses of the government for the fiscal year ending June 30, 1894, and for other purposes," approved August 18, 1894, providing for the irrigation, reclamation, occupation and disposal of desert and arid lands within the state of Colorado (28 Statutes at Large, page 422). Also the act of congress of March 3, 1891 (26 U. S. Statutes at Large, page 1036), relative to the legislation by congress concerning rights of way on the public domain of the United States within the state of Colorado, for canals and ditches, and providing for reservoir sites to be taken under the acts of congress. Also act of 1866, 14 Statutes at Large, 253.

Abrogation of State Legislation of Kansas.

The decision asked in the bill would prevent the carrying into effect an act of the Legislature of Kansas, being chapter 133 of the laws of Kansas of 1891, entitled "Irrigation," which provides that in all that portion of Kansas west of the 99th meridian all natural waters, standing or running, surface or subterranean, shall be devoted, first, to the purposes of irrigation, subject to ordinary domestic uses, and, secondly, to other industrial purposes, and may be diverted from natural beds, basins or channels for such uses and purposes, which act was approved March 10, 1891, and is still in full force and effect.

Conflict between Legislative and Judicial Branches.

The decision on the bill, if complainant succeeds, would be to enjoin Colorado from exercising her

functions of statehood. The state could not coerce her people, because their rights have been acquired by compliance with the various acts of congress. If the state obeyed the mandate of the court it would place itself in opposition to congress, and if it did not it would be guilty of contempt. The court would then be in the peculiar position of enforcing contempt proceedings against a state exercising its sovereign powers agreeably to the acts of congress, which it could not forego without disobedience of legislative provisions.

State Sovereignty can not be Exercised to Protect Riparian Rights.

Riparian rights were never an element of sovereignty. It is a private right attaching to the owner of the soil. The injured party has his remedy at law. The state of Kansas can not invoke the jurisdiction of this court to adjudicate injuries to the property rights of private persons.

For these reasons, apparent from the motion and from the bill as exhibited, it is submitted that leave to file the bill should not be allowed.

Respectfully submitted,

CHAS. C. POST,
Attorney General of Colorado.

No. 8 Orig.

Office Supreme Court
FILED
OCT 15 1901
JAMES H. McKENNEY
Clerk

Demurrer to Bill.

IN THE

Filed Oct. 15, 1901.

SUPREME COURT

OF THE

UNITED STATES.

THE STATE OF KANSAS,
Plaintiff,

vs.

THE STATE OF COLORADO,
Defendant.

(3) Orig.

Demurrer to Bill.

3 Orig'l.
O. T. 1906

LUTHER M. GODDARD,
CHARLES S. THOMAS,
PLATT ROGERS,
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THE SMITH-BROOKS PRINTING CO., DENVER

IN THE

SUPREME COURT

OF THE

UNITED STATES.

THE STATE OF KANSAS,
Plaintiff,

vs.

THE STATE OF COLORADO,
Defendant.

The defendant, according to the statute in such case made and provided, states the following causes of demurrer to the said bill of complaint:

First—That this court has no jurisdiction of either the parties to or the subject matter of this suit because it appears on the face of said bill of complaint that the matters set forth therein do not constitute within the meaning of the Constitution of the United States, any controversy between the state of Kansas and the state of Colorado.

Second—Because the allegations of said bill show that the issues presented by said bill arise, if at all, between the state of Kansas and certain private corporations and certain persons in the state of Colorado who are not made parties herein and which matters so stated, if true, do not concern the state of Colorado as a corporate body or state.

Third—Because said bill shows upon its face that this suit is in reality for and on behalf of certain individuals who reside in the said state of Kansas on the banks of the Arkansas river and that although the said suit is attempted to be prosecuted for and in the name of the state of Kansas said state is in fact loaning its name to said individuals and is only a nominal party to said suit and that the real parties in interest are the said private parties and persons residing in said state.

Fourth—Because it appears from the face of said bill that the state of Kansas in her right of sovereignty is seeking to maintain this suit for the redress of the supposed wrongs of certain private citizens of said state while under the Constitution of the United States and the laws enacted thereunder, said state possesses no such sovereignty as empowers it to bring an original suit in this court for such purposes.

Fifth—Because it appears upon the face of said bill of complaint that no property rights of the state of Kansas are in any manner affected by the matters alleged in said bill of complaint; nor is there any such property right involved in this suit as would give this court original jurisdiction of this cause.

Sixth—Because it appears from the face of said bill of complaint that the acts complained of are not

done by the state of Colorado or under its authority, but by certain private corporations and individuals against whom relief is sought and who are not made parties herein.

Seventh—The bill is multifarious in this, to wit: that thereby the state of Kansas seeks to determine the claims of the state of Kansas as a riparian owner against the claims of the state of Colorado as an appropriator of water; the claims of the state of Kansas as a riparian owner against the separate and severable claims of numerous undisclosed Colorado appropriators of water; the separate and severable claims of various disclosed and undisclosed riparian claimants in Kansas against the claims of the state of Colorado as an appropriator of water; and the separate and severable claims of various disclosed and undisclosed riparian claimants in Kansas against the separate and severable claims of numerous undisclosed Colorado appropriators; and otherwise, as is apparent from the bill.

Eighth—Because the acts and injuries complained of consist of the exercise of rights and the appropriation of water upon the national domain in conformity with and by virtue of divers acts of Congress in relation thereto.

Ninth—Because the Constitution of the state of Colorado declaring public property in the waters of its natural streams and sanctioning the right of appropriation was enacted pursuant to national authority and ratified thereby at the time of admission of the state into the union.

Tenth—Said bill of complaint is in other respects uncertain, informal and insufficient and does not state

facts sufficient to entitle the state of Kansas to the equitable relief prayed for.

Chas. C. Post

Attorney General of the State of Colorado.

L. M. Goddard,

C. S. Thomas,

Platt Rogers,

.....,

Of Counsel.

I certify that, in my opinion, the forego demurrer of the State of Colorado, defendant, the bill of complaint of the State of Kansas, plainant, is well founded in law and proper to filed in the above cause.

Chas. C. Post

Attorney General for the State of Colorado and solicitor for the defe